



21st

**International Metallurgy
and Materials Congress**

21. Uluslararası Metalurji
ve Malzeme Kongresi

CONGRESS PROGRAMME & ABSTRACTS BOOK

KONGRE PROGRAM
ve ÖZET KİTABI

**6-8 October / Ekim
2022, ISTANBUL**

TÜYAP Fair and Congress Center
TÜYAP Fuar ve Kongre Merkezi



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“Global Warming,
Climate Crisis
Küresel Isınma,
İklim Krizi”



immc2022



METEM



21st International Metallurgy and Materials Congress
21. Uluslararası Metalurji ve Malzeme Kongresi

Congress Program & Abstracts Book Kongre Program ve Özet Kitabı

**UCTEA Chamber of Metallurgical
and Materials Engineers Training Center**
TMMOB Metalurji ve Malzeme
Mühendisleri Odası Eğitim Merkezi

Kocatepe Mah. Hatay Sok No: 10/9
06420 Çankaya - Ankara
Mobile: +90 537 527 07 90
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2022

 **METEM**

    immc2022





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 **Çolakoğlu Metalurji**



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SÜPERREF

Prof. Dr. Gehan A. J. Amaratunga	Cambridge University	England
Dr. Khalil Amine	Argonne National Laboratories	USA
Prof. Dr. Diran Apelian	Worcester Polytechnic Institute	USA
Dr. Csaba Balazsi	Hungarian Academy of Sciences	Hungary
Dr. Paola Bassani	CNR ICMATE	Italy
Prof. Dr. Joachim Bill	University of Stuttgart	Germany
Prof. Dr. Simona Cavalu	University of Oradea	Romania
Prof. Dr. Manish Chhowalla	Rutgers University	USA
Prof. Dr. Dan Eliezer	Ben-Gurion Univ. of the Negev	Israel
Prof. Dr. Ahmed Elmarakbi	Northumbria University	UK
Prof. Dr. David Embury	The Univ. of British Columbia	Canada
Prof. Dr. Ing. Bernd Friedrich	IME RWTH Aachen University	Germany
Prof. Dr. Bernd Friedrich	RWTH Aachen University	Germany
Prof. Dr. Maria Pau Ginebra	Univ. Politecnica de Catalunya	Spain
Dr. W. D. Griffiths	University of Birmingham	England
Prof. Dr. Bernd H. Günther	Heinrich-Heine-Univ. Düsseldorf	Germany
Prof. Dr. Fathi Habashi	Laval University	Canada
Prof. Dr. Makoto Hasegawa	Yokohama National University	Japan
Prof. Peter Hodgson	Deakin University	Australia
Dr. Antoniac Vasile Iulian	Univ. Politecnica of Bucharest	Romania
Dr. Florian Kongoli	Flogen Technologies Inc.	Canada/USA
Matthew J. Kramer	Iowa State University	USA
Prof. Dr. R. Vasant Kumar	University of Cambridge	UK
Dr. Thomas Luebben	Foundation Inst. of Materials Sci.	Germany
Prof. Dr. Rodrigo Martins	European Academy of Sciences	Portugal
Dr. Toshio Maruyama	Tokyo Institute of Technology	Japan
Prof. Dr. Sanjay Mathur	University of Cologne	Germany
Dr. Meyya Meyyappan	NASA Ames Research Center	USA
Mathieu Morcrette	Reactive et Chimie des Solides	France
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Dr. Pance Naumov	New York University Abu Dhabi	UAE
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Dr. Sanin Vladimir Nikolaevich	Russian Academy of Science	Russia
Prof. Dr. Besim Ben Nissan	University of Technology	Australia
Dr. Maria Omastova	Slovak Academy of Sciences	Slovakia
Dr. Julietta V. Rau	Istituto di Struttura della Materia	Italy
Prof. Dr. Simion Simon	Babes-Bolyai University	Romania
Dr. Abdelilah Slaoui	European Materials Research Soc.	France
Prof. Dr. Marcel A. J. Somers	Technical University of Denmark	Denmark
Prof. Dr. Michael Stelter	INEMET, TU Freiberg	Germany
Prof. Dr. Mingyue Sun	Chinese Academy of Sciences	China
Prof. Dr. Nickolas J. Themelis	Columbia University	USA
Dr. George E. Totten	Texas A&M University	USA
Prof. Dr. Cong Wang	Northeastern University	China





Prof. Dr. Gökhan ORHAN

Istanbul University-Cerrahpaşa



Prof. Dr. Özgül KELEŞ

Istanbul Technical University



Prof. Dr. Caner DURUCAN

Middle East Technical University

Biomaterials Symposium

Biyomalzemeler Sempozyumu

Doç. Dr. İpek AKIN KARADAYI, Istanbul Technical University

Doç. Dr. Salih DURDU, Giresun University

Doç. Dr. Batur ERCAN, Middle East Technical University

Prof. Dr. Gültekin GÖLLER, Istanbul Technical University

Steel Symposium

Çelik Sempozyumu

Prof. Dr. Arcan DERİCİOĞLU, Middle East Technical University

Prof. Dr. C. Bora DERİN, Istanbul Technical University

Prof. Dr. Ender KESKİNKILIÇ, Atılım University

Non-Ferrous Metals Symposium

Demir Dışı Metaller Sempozyumu

Dr. Öğr. Üyesi Murat ALKAN, Dokuz Eylül University

Prof. Dr. Cem KAHRUMAN, Bursa Technical University

Dr. Öğr. Üyesi Ahmet Orkun KALPAKLI, Istanbul Uni.-Cerrahpaşa

Doç. Dr. Ahmet TURAN, Yeditepe University

Casting Symposium

Döküm Sempozyumu

Yaşar Uğur AKI, Demisaş Döküm

Dr. Arda ÇETİN, Ekstra Metal

Prof. Dr. Ali KALKANLI, Middle East Technical University

Doç. Dr. Necip ÜNLÜ, Istanbul Technical University

Energy Materials Symposium

Enerji Malzemeleri Sempozyumu

Dr. Öğr. Üyesi Gökçe HAPÇI AĞAOĞLU, Istanbul Uni.-Cerrahpaşa

Doç. Dr. Tuğrul ÇETİNKAYA, Sakarya University

Doç. Dr. Burak ÜLGÜT, Bilkent University

Dr. Öğr. Üyesi B. Deniz KARAHAN, Istanbul Technical University

Recycling and Sustainability Symposium

Geri Dönüşüm ve Sürdürülebilirlik Sempozyumu

Dr. Mertol GÖKELMA, Izmir Institute of Technology

Doç. Dr. M. Şeref SÖNMEZ, Istanbul Technical University

Dr. Öğr. Üyesi Mert ZORAĞA, Istanbul University-Cerrahpaşa

Failure Analysis and Heat Treatment Symposium

Hasar Analizi ve Isıl İşlem Sempozyumu

Prof. Dr. Murat BAYDOĞAN, Istanbul Technical University

Utku İNAN, Alpha Metalurji

Aerospace Materials Symposium

Havacılık Malzemeleri Sempozyumu

Prof. Dr. Mustafa GÜDEN, İzmir Institute of Technology

Prof. Dr. Benat KOÇKAR, Hacettepe University

Doç. Dr. Havva KAZDAL ZEYTİN, TÜBİTAK MAM

Dr. Hakan YAVAŞ, TUSAŞ-TAI

Welding and Non-Destructive Testing Symposium

Kaynak ve Tahribatsız Muayene Sempozyumu

Dr. Öğr. Üyesi Caner BATIGÜN, Middle East Technical University

Prof. Dr. Emel TABAN, Kocaeli University

Composite and Polymer Materials Symposium

Kompozit ve Polimer Malzemeler Sempozyumu

Prof. Dr. Cevdet KAYNAK, Middle East Technical University

Prof. Dr. Bora MAVİŞ, Hacettepe University

Doç. Dr. M. Reza NOFAR, İstanbul Technical University

Corrosion and Wear Symposium

Korozyon ve Aşınma Sempozyumu

Dr. Öğr. Üyesi Levent ORGAN, Yeditepe University

Dr. Öğr. Üyesi Çiğdem TOPARLI, Middle East Technical University

Doç. Dr. Fatih TOPTAN, İzmir Institute of Technology

Nanomaterials Symposium

Nanomalzemeler Sempozyumu

Doç. Dr. Z. Gökür BÜKE, TOBB-ETU

Prof. Dr. Sebahattin GÜRMEN, İstanbul Technical University

Prof. Dr. Burak ÖZKAL, İstanbul Technical University

Prof. Dr. H. Emrah ÜNALAN, Middle East Technical University

Ceramics, Glass, Refractory Materials Symposium

Seramik, Cam, Refrakter Malzemeleri Sempozyumu

Prof. Dr. Abdullah ÖZTÜRK, Middle East Technical University

Prof. Dr. Ender SUVACI, Eskişehir Technical University

Prof. Dr. Filiz ÇINAR ŞAHİN, İstanbul Technical University

Prof. Dr. Çekdar Vakıf AHMETOĞLU, İzmir Institute of Technology

Surface Treatment and Coating Symposium

Yüzey İşlemler ve Kaplama Sempozyumu

Doç. Dr. Ekrem ALTUNCU, Sakarya University of Applied Sciences

Doç. Dr. Metehan ERDOĞAN, Ankara Yıldırım Beyazıt University

Prof. Dr. Kürşat KAZMANLI, İstanbul Technical University

Dr. Alper YEŞİLÇUBUK, Arçelik

RSS**Recycling and Sustainability Symposium**

Geri Dönüşüm ve Sürdürülebilirlik Sempozyumu

AMS**Aerospace Materials Symposium**

Havacılık Malzemeleri Sempozyumu

STCS**Surface Treatment and Coating Symposium**

Yüzey İşlemler ve Kaplama Sempozyumu

STS**Steel Symposium**

Çelik Sempozyumu

NFMS**Non-Ferrous Metals Symposium**

Demir Dışı Metaller Sempozyumu

CWS**Corrosion and Wear Symposium**

Korozyon ve Aşınma Sempozyumu

CGRS**Ceramics, Glass, Refractory Materials Symposium**

Seramik, Cam, Refrakter Malzemeleri Sempozyumu

EMS**Energy Materials Symposium**

Enerji Malzemeleri Sempozyumu

FAHTS**Failure Analysis and Heat Treatment Symposium**

Hasar Analizi ve Isıl İşlem Sempozyumu

CPS**Composite and Polymer Materials Symposium**

Kompozit ve Polimer Malzemeler Sempozyumu

WNTS**Welding and Non-Destructive Testing Symposium**

Kaynak ve Tahribatsız Muayene Sempozyumu

BMS**Biomaterials Symposium**

Biyomalzemeler Sempozyumu

NMS**Nanomaterials Symposium**

Nanomalzemeler Sempozyumu

CSS**Casting Symposium**

Döküm Sempozyumu

6 October 2022, Thursday / 6 Ekim 2022, Perşembe
10.15-12:00
Hall Marmara / Salon Marmara

Deepening Climate Crisis and Solutions

Ümit ŞAHİN

Sabancı University
Türkiye

Why Does Humanity Need New Energy Materials,
and Where Will We Find Them?

Taylor SPARKS

University of Utah
USA

Assessment of Net Zero Emissions Targeting
against the Global Climate Crisis and the Problem
of Climate Justice

Alp Erinç YELDAN

Kadir Has University
Türkiye



8 October 2022, Saturday / 8 Ekim 2022, Cumartesi
Hall Büyükada / Salon Büyükada

13.30-14.00 Industrial Welding Applications of S690QL Grade Steels
Tanıl ATICI
Cimtas Steel Research & Development Center
Türkiye

7 October 2022, Friday / 7 Ekim 2022, Cuma
Hall Karadeniz / Salon Karadeniz

13.30-14.00 Multi-Materials 3D Printing Of Ceramics
Lisa BIASETTO
University of Padova
Italy

6 October 2022, Thursday / 6 Ekim 2022, Perşembe
Hall Karadeniz / Salon Karadeniz

14.40-15.10 Carbon-Based PVD Coating Solutions for a Sustainable Future
Ivan KOLEV
IHI Hauzer Techno Coating B.V.
Netherlands

6 October 2022, Thursday / 6 Ekim 2022, Perşembe
Hall Marmara / Salon Marmara

13.00-13.30 The Enabling Role of Materials Chemistry Towards Net-Zero Carbon
Ramachandran Vasant KUMAR
University of Cambridge
United Kingdom

8 October 2022, Saturday / 8 Ekim 2022, Cumartesi
Hall Karadeniz / Salon Karadeniz

14.00-14.30 New Polymorphs of Compounds With A Complex, Layered Crystal Structure Stabilized At The Nanoscale: Magnetic Strontium-Hexaferrite Nanoplatelets And Ferroelectric Bismuth-Titanate Nanowires
Darko MAKOVEC
Jožef Stefan Institute
Slovenia

7 October 2022, Friday / 7 Ekim 2022, Cuma
Hall Karadeniz / Salon Karadeniz

11.20-11.50 Tribocorrosion Degradation of Osteointegrated Biomedical Implants: Mechanisms, Biological Implications and (Possible) Solutions
Luis Augusto ROCHA
Digital Transformation CoLAB
Portugal

6 October 2022, Thursday / 6 Ekim 2022, Perşembe
Hall Büyükkada / Salon Büyükkada

16.20-16.50 Materials for Extreme Environments: On The Outside Looking in
Ali SAYIR
Air Force Office of Scientific Research
USA

8 October 2022, Saturday / 8 Ekim 2022, Cumartesi
Hall Marmara / Salon Marmara

10.40-11.10 Transition Metal Free: Dual Ion and Dual-Carbon Batteries
Martin WINTER
University of Münster & Helmholtz-Institute Münster
Germany



**Tanıl ATICI**

Tanıl Atıcı was born in Ankara in 1983. He was graduated from Middle East Technical University Metallurgical and Materials Engineering Department as BSc in 2006. In 2009, he was graduated from Welding Engineering course given by Middle East Technical University Welding Technologies Center. Since 2007, he is working as a welding engineer in Cimtas Steel company. He holds CWI (certified welding inspector) certificate of AWS (American Welding society). He is the director of Cimtas Steel Research & Development Center.

**Lisa BIASETTO**

Lisa Biasetto is Associate Professor at the Department of Management and Engineering of University of Padova since 2018, where she teaches Materials Science and Technology and Polymers Technology at the bachelor and master's degree Program of Product Innovation Engineering.

In 2007 she earned a PhD in Materials Engineering from University of Bologna-Italy. After the PhD she has been post doc researcher at Istituto Nazionale di Fisica Nucleare and researcher at UNIPD. Her collaborations over the years span from CERN-Geneve, ORNL-Tennessee-USA, TRIUMF-Vancouver-Canada, University of Colorado at Boulder-Colorado-USA, Technical University of Darmstadt, Germany, EPFL-Lousanne-Switzerland, Loughborough University-UK, Saarland University-Germany, Maribor University-Slovenia, Fraunhofer-IFAM, Germany..

Her major field of interest includes synthesis, processing, and characterization of porous components (ceramics, metallic and mixture thereof), coating technologies, non-energy deposition additive manufacturing technologies, biomaterials and ultra-high temperature ceramics for production of isotope beams.

She published more than 60 papers in international peer reviewed journals. She has coordinated or she has been involved as principal investigator in several research projects funded by EU, Italian Government, and private companies.

**Ivan KOLEV**

Professional Experience

2008 – Present: IHI Hauzer Techno Coating B.V.
Van Heemskerckweg 22
5928 LL – Venlo, The Netherlands

2018 – Present Process Technology Manager
2016 – 2018 Process Manager Strategical R&D
2009 – 2016 Process Manager Deco and Special
2008 – 2009 Senior Process Engineer

2007 – 2008 University of Antwerp, Belgium
Position: Research fellow, member of staff

Education

Doctor of Philosophy in Plasma Physics (PhD), 2006 University of Antwerp, Belgium
Master of Science in Engineering Physics (MSc), 1999 University of Sofia, Bulgaria
Bachelor of Science in Engineering Physics (BSc), University of Sofia, Bulgaria



R. Vasant KUMAR

R Vasant Kumar is Professor and the Head of Materials Chemistry Group and a Fellow of the Institute of Energy and a Fellow of the Institute of Materials, Mining and Metallurgy. He has published over 370 papers, 20 patents, 12 Chapters in Handbooks and 1 edited book (High energy density Li batteries, Wiley-VCH 2010- also translated in Chinese, 2013, 2nd Edition in 2022). He has supervised 40+ PhD students, 40+ post-doctoral researchers, 20 visiting students and hosted over 15 visiting professors.

He is Honorary/Guest Professor in 5 overseas Universities (2008, 2012, 2016, 2019, 2021). Has received Honorary Engineering Degree in University of Malaysia (2011), Kroll Medal from IOM3; Armourers & Brasiers Enterprise Award for translating research into industrial applications (2014).

He is the Editor-in-Chief of IOM3 journal, "Mineral Processing & Extractive Metallurgy" from 2004, Editorial Board Member of (i) "Advances in Nanoparticles" of Scientific Research Publishing from 2012; (ii) "Materials Today Chemistry" of Elsevier Ltd from 2017; (iii) Materials Circular Economy, Singapore from Oct 2018, and a Board Member of IOM3's Technical Division. He is Advisory Board Member of TECHMET Ltd, London (from 2019) and Korea National Lithium Research Centre (from 2020).

Many of his research has led to licenses and industrial practices and he has founded four start-up companies which are commercialising some of his inventions. Currently, Professor Kumar's research group is working on several research projects underpinned by harnessing of chemical reactions in a variety of applications that range from energy devices such as batteries and fuel cells to environmental research in mineral carbonation, sensors, sustainability and recycling of materials and photocatalytic reactions. rialization, and economics of climate change, and on empirical, dynamic general equilibrium models.

**Darko MAKOVEC**

Prof. dr. Darko Makovec is full professor, head of Department for Materials Synthesis and scientific chancellor at Jožef Stefan Institute. He has defended his PhD from chemistry at the University of Ljubljana in year 1995. In 2001-2002 he worked as a Fulbright senior scholar at University of Illinois at Urbana-Champaign, USA. His scientific interests are focused on synthesis and characterization of the inorganic and hybrid nanomaterials, especially materials containing magnetic nanoparticles. He is also expert in advanced electron microscopy. Prof Makovec has published over 200 peer-review articles.

**Luis A. ROCHA**

Luís Augusto Rocha is a Leading Researcher at DTx - Digital Transformation CoLAB, Campus de Azurém, Guimarães, Portugal. Formerly he was Associated Professor with Habilitation (Livre-Docente) at UNESP - Univ. Estadual Paulista, Faculdade de Ciências de Bauru, Brazil (2013-2018) and Associated Professor at the Department of Mechanical Engineering of University of Minho, in Portugal (1985-2013). He is the coordinator of the IBTN/Br, Brazilian Branch of the Institute of Biomaterials, Tribocorrosion and Nanomedicine, and co-founder of its European Branch.

He has a strong involvement in research on the biomaterials field, namely on the development of functionally graded materials (FGM), surface functionalization of metallic biomaterials and on the investigation of the degradation mechanisms of those materials, essentially from the tribocorrosion point-of-view, and its influence on biological systems. He published more than 100 papers in SCI Journals (h-index=39, according to Google Scholar). In 2021, he was ranked in the World's Top 2% Scientists List, compiled by Stanford University (Materials).

He is a member of WP18 on Tribocorrosion (European Federation of Corrosion), LGM-AS - Int. Assoc. for Layered and Graded Materials (World Academy of Ceramics) and International Advisory Board on Functionally Graded Materials (FGM Forum, Japan).

At DTx he is the Director of the Human Factors technical-scientific area, where he coordinates a multidisciplinary team, including Designers, Social Scientists, Economists, Psychologists etc. This team is building the DTx Living Lab focused on the involvement of humans in the process of co-creation of cyber-physical systems.

**Ali SAYIR**

Dr. Ali Sayir is currently the Program Manager for Materials with Extreme Properties portfolio within the Air Force Office of Scientific Research (AFOSR) in Arlington, VA. As a senior program officer Dr. Sayir has concerted effort on mathematic quantification of microstructures for DOD and leads major national programs in computational material science. He has responsibility for planning, directing, and securing long-term program support in extreme environment electronics and materials for quantum information sciences.

As a Program Officer, Dr. Sayir proactively evaluates materials for extreme environments, and judiciously sponsors innovative scientific opportunities in materials that can be integrated in the ab-initio design process for far-from equilibrium effects, and extreme non-linearity's, and ultra-fast control. He is in forefront in the development and execution of basic research on materials far from equilibrium for high-power systems and interested in new capabilities in materials that can adapt to external stimuli of electric-, magnetic-, acoustic-, thermal fields and combined loads. He is proactive member of DOD and scientific community, and coordinates research programs within the Air Force, DOD, and Army, Navy, DARPA, NASA and other national and international organizations.

Prior to joining AFOSR, Dr. Sayir managed materials and structures for NASA Hypersonic program at NASA Glenn Research Center, Cleveland, OH. He coordinated materials and structures projects between NASA centers, Department of Defense, Industry and Academia. Since 2008 he has held a Professor Faculty appointment at Case Western Reserve University in the Department of Materials Science of Engineering and has been founding member of a small company.

Dr. Sayir conducted research in areas such as eutectic solidification, electron emitters, high temperature piezoelectric materials, and materials for thermoelectric and thermophotovoltaic energy conversion, and proton conducting ceramics. He published 137 peer reviewed publications, 2 book chapters, received 3 patents, have over 40 invited presentations, and was selected a Fellow of the American Ceramic Society since 2009 for his scientific contributions and fellow of AFRL since 2020.

**Taylor SPARKS**

Dr. Sparks is an Associate Professor of Materials Science and Engineering at the University of Utah. He holds a BS in MSE from the UofU, MS in Materials from UCSB, and PhD in Applied Physics from Harvard University. He was a recipient of the NSF CAREER Award and a speaker for TEDxSaltLakeCity.

When he's not in the lab you can find him running his podcast "Materialism" or canyoneering with his 4 kids in southern Utah.

**Ümit ŞAHİN**

Ümit Şahin is Senior Scholar and the Coordinator of Climate Change Studies at Istanbul Policy Center. Şahin teaches courses on Global Environmental Challenges, Climate Change and Environmental Politics at Sabanci University Faculty of Arts and Social Sciences.

Since the early 1990s, Şahin has been part of the green political movement and climate, ecology and environmental movements, and an active contributor to anti-nuclear and human rights movements. Şahin was the editor-in-chief of the green political journal “Üç Ekoloji” (Three Ecologies) that he has founded in 2003.

Şahin is one of the founders of the Association of the Doctors for the Environment, serving as the organization's president, Şahin coordinated the “Turkey sign Kyoto!” campaign, which was carried out by Turkey's Green Party, for whom he was one of the founders and served as co-spokesperson between 2010 and 2012. He also has participated as an observer to the UNFCCC Climate Conferences (COPs) since 2008. He served as a member of Steering Committee of the Istanbul City Council.

Together with Ömer Madra, Şahin has been the producer and host of the “Açık Yeşil” (Open Green) radio program on Açık Radio since 2008. In addition, he edits and writes on climate change and environmental issues for “Yeşil Gazete” (Green Newspaper).

Şahin authored and edited several books, such as “Why We Can't Wait: Global Warming and Climate Crisis”, 2007 (with Ömer Madra, as interviewer and editor), “Green Economy”, 2012 (as co-editor with Ahmet Atıl Aşıcı), Open Green 1 - An Ecology Guide with Its Theory and Practice, 2019, and Open Green 2 - Climate Crisis, Politics, and Activism, 2020 (as co-author with Ömer Madra). Şahin has also several book chapters, policy papers and articles related to climate change, energy transition, environmental health, green politics, and human rights.

Ümit Şahin graduated from Cerrahpaşa Medical School in 1991, completed his Master of Public Health in Hebrew University and received his Ph.D. degree in public health from Istanbul University in 2000. His public health works has focused on environmental health.

**Martin WINTER**

Martin Winter has been researching in the field of electrochemical energy storage and conversion for more than 30 years. His focus is on the development of new materials, components and cell design for lithium ion, lithium-metal batteries and alternative battery systems. Martin Winter currently holds a professorship for “Materials Science, Energy and Electrochemistry” at the Institute of Physical Chemistry at the University of Münster, Germany. The full professorship developed from an endowed professorship funded by the companies Volkswagen, Evonik Industries and Chemetall (today Albemarle) from 2008 to 2012.

Martin Winter is founder and scientific director of MEET Battery Research Center at the University of Münster. MEET stands for “Münster Electrochemical Energy Technology”. At MEET, an international team of about 150 scientists, engineers and technicians is working on research and development of innovative electrochemical energy storage devices with higher energy density, longer durability and maximum safety. Since 2015, he is also founding director of the Helmholtz-Institute Münster (HI MS) “Ionics in Energy Storage”, a division of Forschungszentrum Jülich, with about 70 employees. MEET and HI MS are internationally leading institutions in the research and development of innovative electrochemical energy storage systems.

**Alp Erinç YELDAN**

A. Erinç Yeldan, Professor of Economics and Dean at Kadir Has University. He is one of the executive directors of the International Development Economics Associates (IDEAs), New Delhi; and serves as a member-elect of the International Resource Panel of the UN Environment Programme (UNEP). He is also a member-elect of the Science Academy (Bilim Akademisi) in Turkey.

Dr Yeldan received his Ph.D. from University of Minnesota, USA, and joined the Department of Economics at Bilkent in 1988. During 1994/95 he was a visiting scholar at the University of Minnesota, and during 2007/2008 he was a Fulbright scholar at University of Massachusetts, Amherst and at Amherst College. Dr. Yeldan's recent work focuses on development macroeconomics, vulnerability and fragmentation of labor markets, de-industrialization, and economics of climate change, and on empirical, dynamic general equilibrium models.



AÇILIŞ TÖRENİ / OPENING CEREMONY

ANKIROS 2022 - TURKCAST 2022

21. ULUSLARARASI METALURJİ VE MALZEME KONGRESİ / 21st INTERNATIONAL METALLURGY & MATERIALS CONGRESS

11. ULUSLARARASI DÖKÜM KONGRESİ / 11th INTERNATIONAL FOUNDRY CONGRESS

YER / VENUE: TÜYAP- Fuar ve Kongre Merkezi, İstanbul - Hol 2-3 Fuaye / TUYAP Fair and Convention Center, İstanbul - Halls 2-3 Foyer

TARİH / DATE: 05 EKİM 2022, 18:30 / 05 OCTOBER 2022, 18:30

AÇILIŞ KONUŞMALARI / OPENING SPEECHES

İbrahim ANIL

HANNOVER MESSE ANKIROS FUARCILIK A.Ş.

MURAHHAS AZA VE GENEL MÜDÜR / EXECUTIVE DIRECTOR AND GENERAL MANAGER

Dr. Timo WÜRZ

CECOF / CEMAFON

GENEL SEKRETER / GENERAL SECRETARY

EUnited Metallurgy

DİREKTÖR / DIRECTOR

Prof. Dr. Gökhan ORHAN

21. ULUSLARARASI METALURJİ VE MALZEME KONGRESİ

21st INTERNATIONAL METALLURGY & MATERIALS CONGRESS

ORGANİZASYON KURULU BAŞKANI / CHAIRMAN OF THE ORGANIZING COMMITTEE

Ata ÖZDEMİRLER

TMMOB METALURJİ VE MALZEME MÜHENDİSLERİ ODASI EĞİTİM MERKEZİ (METEM)

UCTEA CHAMBER OF METALLURGICAL AND MATERIALS ENGINEERS TRAINING CENTER

YÜRÜTME KURULU BAŞKANI / CHAIRMAN OF EXECUTIVE BOARD

Ahmet İrfan TÜRKKOLU

TMMOB - METALURJİ VE MALZEME MÜHENDİSLERİ ODASI

UCTEA - CHAMBER OF METALLURGICAL AND MATERIALS ENGINEERS

YÖNETİM KURULU BAŞKANI / CHAIRMAN OF EXECUTIVE BOARD

Dr. Veyssel YAYAN

"TÇÜD"- TÜRKİYE ÇELİK ÜRETİCİLERİ DERNEĞİ

TURKISH STEEL PRODUCERS ASSOCIATION

GENEL SEKRETER / SECRETARY GENERAL

Kadir EFE

"TÜDÖKSAD"- TÜRKİYE DÖKÜM SANAYİCİLERİ DERNEĞİ

TURKISH FOUNDRYMEN'S ASSOCIATION

YÖNETİM KURULU BAŞKANI / CHAIRMAN OF THE BOARD





CONGRESS SESSIONS

KONGRE OTURUMLARI





Opening Session

Açılış Oturumu



Opening Session

Session Chairman / Oturum Başkanı: CANER DURUCAN

10.15-12.00

Deepening Climate Crisis and Solutions

Ümit ŞAHİN

Sabancı University
Türkiye

Assessment of Net Zero Emissions Targeting Against The Global Climate Crisis and The Problem of Climate Justice

Alp Erinc YELDAN

Kadir Has University
Türkiye

Why Does Humanity Need New Energy Materials, and Where Will We Find Them?

Taylor SPARKS

The University of Utah
USA



RSS

Recycling and Sustainability Symposium

Geri Dönüşüm
ve Sürdürülebilirlik
Sempozyumu



RSS

Session 1

Session Chairman / Oturum Başkanı: M. ŞEREF SÖNMEZ

The Enabling Role Of Materials Chemistry Towards Net-Zero Carbon

13.00-13.30

R. Vasant KUMAR

University of Cambridge
United Kingdom

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(Invited Speaker)

Investigating The Effect of Mechanical Pretreatment on The Recovery Rate of Critical Raw Materials from Discarded Hard Disc Drives

13.30-13.50

Alireza HABİBZADEH, Mehmet Ali KÜÇÜKER, Mertol GÖKELMA

Izmir Institute of Technology
Türkiye

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Iron Removal from NdFeB Waste Magnet Solutions Using Sodium Alginate Solution

13.50-14.10

Emircan UYSAL¹, Elif EMİL KAYA^{1,2,3}, Serhat AL¹, Sebahattin GÜRMEH

¹Istanbul Technical University, ²RWTH Aachen University,

³Turkish-German University
Türkiye, Germany

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Investigation of Dissolution Parameters of Rare Earth Elements in Fluorescent Wastes by Microwave Leaching

14.10-14.30

Ayşegül BİLEN, Utku HATİPOĞLU, Muhlis Nezihi SARIDEDE

Yıldız Technical University
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Characterization and Extraction of Heavy Metals from Municipal Solid Waste Incineration Fly Ash**Jonas SCHUSTER^{1,2}, Burçak EBİN¹**¹Chalmers University of Technology,²Hamburg University of Technology

Sweden, Germany

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Production of Metal Sulfides from Ferrochrome Flue Dusts and Investigation of Their Electrochemical Properties**Ozan AYDIN, Metin GENÇTEN, Burak BİROL**

Yıldız Technical University

Türkiye

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Page 108

Li-Ion Battery Recycling for Industrial Scale**Safiye TANRIVERDİ^{1,2}, Berk GÜLÖRTEN², Mahmut KARADAŞ²**¹Istanbul University - Cerrahpasa,²Proses Makine

Türkiye

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Recovery of End-Of-Life Lithium-Ion Battery Cathode Materials in Acidic Media**Elif GÜLOĞLU¹, Mert ZORAĞA¹, Gökçe HAPÇI AĞAOĞLU¹, Ş. Samet KAPLAN², M. Şeref SÖNMEZ², Sebahattin GÜRMEN², Gökhan ORHAN¹**¹Istanbul University-Cerrahpasa, ²Istanbul Technical University
Türkiye

RSS

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Is Sustainability a Paradigm for Occupational Health and Safety?

Murat Can OCAKTAN

UCTEA Chamber of Metallurgical and Materials Engineers
Türkiye

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Remelting Behaviour of Pure and AZ63 Magnesium Chips

Pınar YÖRÜK¹, Bora DERİN², Mertol GÖKELMA¹

¹Izmir Institute of Technology,
²Istanbul Technical University
Türkiye

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Scrap-Salt Flux Interactions During Recycling Processes

**İrem Yaren ÇAPKIN¹, Adamantia LAZOU²,
Gabriella TRANELL², Mertol GÖKELMA¹**

¹Izmir Institute of Technology,
²Norwegian University of Science and Technology
Türkiye, Norway

17.20-17.40

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Tin Recovery from Electrolytic Tinning Line (ETL) Scraps

**Gizem KAVUK¹, Anıl AGADANGİL¹,
Miyase Özlem KÖYBAŞI ÖZUÇAK¹,
S. Samet KAPLAN¹, M. Şeref SÖNMEZ²**

¹TOSÇELİK, ²Istanbul Technical University
Türkiye



AMS

Aerospace Materials Symposium

Havacılık Malzemeleri
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Dynamic Recrystallization in Directional Solidified CM247 LC Alloys

Müge AKDEMİR¹, Belgin ATAMAN¹, Aylin ŞAHİN KAHRAMAN², Havva KAZDAL ZEYTİN², Hüseyin AYDIN²

¹Istanbul Technical University, ²TUBITAK Marmara Research Center
Türkiye

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Cold Spray Effect on Oxide Dispersion Strengthening of Inconel 718

Bayram Berk TANRISEVDİ, Eda AYDOĞAN

Middle East Technical University
Türkiye

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Flowforming and Heat Treatment Effect of IN718 Alloy

Aptullah KARAKAŞ

Repkon Machine and Tool Industry
Türkiye

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A Numerical Analysis of the Effect of Electro-Beam-Melt Ti6Al4V Cover Plate on the Ballistic Performance of SiC Armor**F. Murat YILDIZTEKİN¹, Mustafa GÜDEN¹,
Alper TAŞDEMİRCİ¹, A. Kaan TOKSOY²,
Gülden ÇİMEN¹, S. Burçin ÇELLEK¹**¹Izmir Institute of Technology, ²Roketsan Missiles Industries
Türkiye

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Effect of Solution Heat Treatment on the Anisotropy of Microstructure, Texture and Mechanical Properties of Hastelloy X Fabricated by Laser Powder Bed Fusion**Seren ÖZER^{1, 2}, M. Alp YALÇIN¹, Güney Mert BİLGİN²,
Kemal DAVUT³, Ziya ESEN⁴, Arcan F. DERİCİOĞLU²**¹Atılım University, ²Middle East Technical University,
³Izmir Institute of Technology, ⁴Çankaya University
Türkiye

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Page 127

Effects of Heat Treatment and Hot Isostatic Pressing on High Temperature Mechanical Properties of Ti-48Al-2Cr-2Nb Alloy Produced by Electron Beam Melting**Güney Mert BİLGİN^{1,2}, Seren ÖZER^{2,3} Ziya ESEN⁴,
Arcan F. DERİCİOĞLU²**¹TUSAS Engine Industries, ²Middle East Technical University,
³Atılım University, ⁴Çankaya University
Türkiye

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The Effect of Powder Bed Fusion and Direct Deposition Methods on Metallic Materials**Murat ISIK**
Uludag University
Türkiye

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Session Chairman / Oturum Başkanı: BENAT KOÇKAR

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Materials for Extreme Environments: On The Outside Looking in

Ali SAYİR

Air Force Office of Scientific Research
USA

(Invited Speaker)

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Page 130

Evaluation of Proficiency Test Results in Fatigue Test in Aerospace Metallic Materials

**Bülent AYDEMİR¹, Hüseyin AYDIN², Fatih GÜLER²,
Aygün GÜNGÖR², İbrahim KÜÇÜKOĞUL², Havva
KAZDAL ZEYTİN²**

¹Tübitak UME, ²Tübitak MAM
Türkiye

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Page 131

Mechanical Behavior of Repaired Carbon Fiber Reinforced Polymer Composite Laminates

Evren SONAT^{1,2}, Mete BAKIR^{2,3}, Sezer ÖZERİNÇ¹

¹Middle East Technical University,

²Turkish Aerospace Industries,

³Yıldırım Beyazıt University

Türkiye

17.30-17.50

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Microstructural Evolution of CMSX-4 SLS Single Crystal Superalloys during Creep Rupture Tests

**Aylin ŞAHİN KAHRAMAN¹, Burak HORASAN²,
Havva KAZDAL ZEYTİN¹, Hüseyin AYDIN¹,
Cevat Fahir ARISOY³**

¹Tübitak MAM, ²Sakarya University,

³Istanbul Technical University

Türkiye



STCS

Surface Treatment and Coating Symposium

Yüzey İşlemler ve
Kaplama Sempozyumu



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ZnO Nanowire Growth via Anodization

Yiğithan TUFAN, İpek Tuğçe DÖŞ, Batur ERCAN

Middle East Technical University
Türkiye

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Production and Characterization of Gold Nanofilms on Transparent Substances by Electrodeposition Method

Uğur BARUT, Metehan ERDOĞAN

Ankara Yıldırım Beyazıt Üniversitesi
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Effect of Substrate Bias on Mechanical Properties of Magnetron Sputtered AlTiN-B₄C Films

Özden KISACIK^{1,2}, Cennet YILDIRIM^{1,3}, Erkan KAÇAR^{1,4}, Servet TURAN², Sedat SÜRDEM⁵

¹Boron Research Institute, ²Eskişehir Technical University,

³Istanbul Technical University, ⁴Hakkari University,

⁵Gazi University

Türkiye

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Effect of Micro Arc Oxidation and Precipitation Hardening on The Corrosion Resistance of 7075 Al Alloy Fabricated by Flow Forming

Belgin ATAMAN¹, Serra BAYRAM¹, Mertcan KABA¹, Aptullah KARAKAŞ^{1,2}, Murat BAYDOĞAN¹, Hüseyin ÇİMENÖĞLU¹

¹Istanbul Technical University, ²Repkon Makina ve Kalıp
Türkiye

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Session 2

Session Chairman / Oturum Başkanı: **EKREM ALTUNCU**

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Page 142

Carbon-Based PVD Coating Solutions for a Sustainable Future**Ivan KOLEV**IHI Hauzer Techno Coating B.V.
Netherlands

(Invited Speaker)

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Page 143

Effect of Aluminizing on the High Temperature Oxidation Behavior of Inconel 718 Superalloy**Y. Burak TELBAKİROĞLU, Erkan KONCA**Atılım University
Türkiye

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Page 144

Improving Fracture Toughness of AlTiN Hard Coatings by W Additions**Burçin KAYGUSUZ¹, Amir MOTALLEBZADEH²,
Özcan Doğu KARADAYI³,
Muhammed Kürşat KAZMANLI⁴, Sezer ÖZERİNÇ¹**¹Middle East Technical University, ²Koç University, ³Ionbond Turkey Yüzey Teknolojileri, ⁴Istanbul Technical University
Türkiye

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Page 145

Performance and Wear of Vacuum Brazed Diamond Cutting Tools With Reinforced Electrolysis Coating**Berrak BULUT¹, Yunus Emre ERBAY², Isil KERTİ²,
Murat BAYDOĞAN¹**¹Istanbul Technical University, ²Yıldız Technical University
Türkiye

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Session Chairman / Oturum Başkanı: **ALPER YEŞİLÇUBUK**

16.20-16.40 Page 146	For More Sustainable Cold Forging Process: Use of Sand Blasting Instead of Pickling and Rinsing Baybars SARICA, M. Burak TOPARLI, Doğu ZEREN, Umut İNCE Norm Cıvata Türkiye
16.40-17.00 Page 147	Investigation of Mechanical and Corrosion Properties of Electroless Ni-W-Co-SiC Multicomponent Coatings İsmail Deniz Kağan DEMİR¹, Göksel HIZLI², Selim ERTÜRK², Kürşat KAZMANLI² ¹ TR Mekatronik Sistemler, ² Istanbul Technical University Türkiye
17.00-17.20 Page 148	Sol-Gel Spray Coating of Aluminium Alloys for The Automotive Applications Çisem ÇELİK KURTULAN^{1,2}, Ş. Samet KAPLAN¹, M. Şeref SÖNMEZ¹ ¹ Istanbul Technical University, ² Nuclear and Mine Research Institution Türkiye
17.20-17.40 Page 149	Wear and Corrosion Performance Evaluation of Laser Claded Brake Disc Ekrem ALTUNCU¹, Recep AKYÜZ², Çiğdem DİNDAR², Cem ÖZTÜRK² ¹ Sakarya University of Applied Sciences, ² Tofas Automotive Türkiye
17.40-18.00 Page 150	A Comparative Study On Corrosion Properties of Decorative Chromium and PVD Evaporated Aluminium Coated ABS Parts Aleyna BAYATLI¹, Arif AKILLILAR², Mustafa KOCABAŞ¹ ¹ Konya Technical University, ² Tosunogulları Mobilya Türkiye



STS

Steel Symposium

Çelik Sempozyumu



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Session Chairman / Oturum Başkanı: BORA DERİN

10.00-10.20

Page 157**Evaluation of Chromite Ores by Metallothermic Process in EAF****Hasan GÜNEY, Selçuk KAN, Kağan BENZEŞİK, Onuralp YÜCEL**Istanbul Technical University
Türkiye

10.20-10.40

Page 158**Determining Optimum Roasting Conditions of Hematite Magnetization with Temperature-Coke Mixture Copula****Zeynep Hazal YAZĞAN¹, Mikail BAŞYİĞİT¹, Abdullah BUHUR², Elif UZUN KART¹**¹Marmara University, ²ARGETEST
Türkiye

10.40-11.00

Page 159**Effect of Ladle Frunace Slag on Steel Cleanliness of Tirecord Steel in Isdemir Plant****İlker AYÇİÇEK¹, Nuri SOLAK², Memduh Kağan KELER³**¹İskenderun Demir ve Çelik A.Ş., ²İstanbul Teknik Üniversitesi,
³Ereğli Demir ve Çelik A.Ş.
Türkiye

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Session 2

Session Chairman / Oturum Başkanı: ENDER KESKİNKILIÇ

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Synthesis of Nanocrystalline Stainless Steels by Mechanical Alloying: Grain Growth, Phase Transformation, Thermal Stability and Mechanical Properties

Hasan KOTAN

Necmettin Erbakan University
Türkiye

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Page 161

Design and Investigation of The Mechanical Properties of Light Alloys For Electric Vehicles

**Ayşen Ceren DERELİ^{1,2}, Ahmet Salih YILMAZ²,
Ufuk BALIKÇI², Onuralp YÜCEL¹**

¹Istanbul Technical University, ²Anadolu Isuzu Otomotiv
Türkiye

12.00-12.20

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Coil Slumping in Peritectic Steels

**Koray ARAY¹, Ahmet SAĞLAM¹, Metin KATRANCI¹,
Hasan YILDIRIM¹, Burcu SOYSAL ATAN¹,
Fatih ÇELİK¹, Abdurrahman Mesud ÇAKIR¹,
Erhan SAKALLI²**

¹İskenderun Demir ve Çelik A.Ş., ²Ereğli Demir ve Çelik A.Ş.
Türkiye

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Page 163

Reducing Quality Cost by Reducing Transverse Surface Crack Defect in Slab Grades

**Kübra AKGÜN, İlker AYÇİÇEK, Hakan KAPUSUZ,
Burcu Soysal ATAN, Murat SARIOĞLU**

İskenderun Demir ve Çelik A.Ş.
Türkiye

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Investigation of Microstructural Properties of Fish Scale Resistant Low Carbon Enamel Steel Grades

Ramazan UZUN, Mehmet Bulut ÖZYİĞİT, Yasemin KILIÇ, Oğuz GÜNDÜZ

Eregli Iron and Steel
Türkiye

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The Role of Thermomechanical Rolling in Petroleum Pipe Steels and Its Effects on Mechanical Properties

Serdar GÜNBAY, Cemre KEÇECİ, Koray ARAY

İskenderun Demir ve Çelik A.Ş.
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Effect of Isothermal Transformation on Microstructural and Mechanical Properties of a Low Carbon Microalloyed Bainitic Forging Steel

M. Mustafa BALCILAR, Bilgehan ÖGEL

Middle East Technical University
Türkiye

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Page 167

Experimental Investigation and Theoretical Expression of The Effect of Steel Wire Rope Parameters on Breaking Load

Emre BAŞER^{1,2}, Yıldız ŞAHİN², Murat POLAT¹

¹Çelik Halat ve Tel Sanayii A.Ş., ²Kocaeli University
Türkiye

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Session 4

Session Chairman / Oturum Başkanı: **KELAMİ ŞEŞEN**

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Thermodynamic Investigation of Kappa-Carbide Phase Change in Low-Density Steels**Memduh Kağan KELER^{1,2}, Sibel DAĞLILAR¹,
Oğuz GÜNDÜZ², Özcan BAHAROĞLU², Onur KART²**¹Yıldız Technical University, ²Eregli Iron and Steel
Türkiye

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Page 169

The Modeling of Mechanical Properties of Low-Carbon Grade (SAE J403:2014 1006, SAE J403:2014 1008, SAE J403:2014 1010) Wire Rod Steels**Ahmet SAĞLAM, Burcu SOYSAL ATAN, İlker
AYÇİÇEK, Hamdi GÜL, Mustafa TÜRKMANİ, Mehmet
Eriş DURUMUŞOĞLU, Abdurrahman Mesud ÇAKIR**İskenderun Demir ve Çelik A.Ş.,
Türkiye

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Page 170

Modelling of Monoblock Loads by Quality Based Process Parameters to Ensure Optimum Production Speed at Wire Rod Mill**Hamdi GÜL¹, Hasan Ozan TEMİZ¹, Mustafa Özden
ÖZDEMİR¹, Tayfun KOCABAŞ², Abdurrahman
Mesud ÇAKIR¹, Fatih ÇELİK¹, Burcu SOYSAL ATAN¹**¹İskenderun Demir ve Çelik A.Ş., ²Oyak Maden Metalurji
Türkiye

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Page 171

Reduction of Emissions While Removing Dust From Isdemir New Blast Furnace Dust Catcher**Onur Hüseyin MEMİŞ, Ümit GEBENLİ, İbrahim
ÇAKMAK, Mustafa BAŞSU**İskenderun Demir ve Çelik A.Ş.,
Türkiye

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Session 5

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Understanding Carbon Dioxide Emissions in Electric Arc Furnace Operations

Mehmet Fatih GÖKÇE¹, Bora DERİN²

¹Diler Demir Çelik, ²Istanbul Technical University
Türkiye

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Page 173

Emissions Occuring in The Cooking Process in Steel Manufacturing and Methods of Struggle Against Emissions

Hüseyin KALAY, Zekeriya ÖZER, Kenan AKDEMİR

İskenderun Demir ve Çelik A.Ş.
Türkiye

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Decarbonization and Green Steel Production in Iron and Steel Industry

Aziz KILIÇ

BCS Enerji Mühendislik
Türkiye



NFMS

Non-Ferrous Metals Symposium

Demir Dışı Metaller
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Production of Functionally Graded Materials Based on FLG Reinforced Al-4.5Cu-1.5Mg by Powder Metallurgy

Gökçe BORAND, Deniz UZUNSOY

Bursa Technical University
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Effect of Anodizing Thickness on Corrosion Behaviour of 2011 Aluminium Alloy

**İlyas Artunç SARI^{1,2}, Gökem ÖZÇELİK¹,
Onuralp YÜCEL²**

¹ASAS Aluminium, ²Istanbul Technical University
Türkiye

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Investigation and Fe Analysis of Earing Amount and Direction of Deep Drawing Process of an Aluminium Sheet Under Various Condition

**Melih ÇAYLAK, Koray DÜNDAR, Yusuf ÖZÇETİN,
Gökem ÖZÇELİK, Ali ULUS**

ASAŞ Alüminyum
Türkiye

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Session 2

Session Chairman / Oturum Başkanı: **TANER AKBAY**

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Reducing Energy Consumption During Heat Treatment of Cast Aluminum Alloys - Optimization of Process Parameters Through CALPHAD**Emre ÇINKILIÇ¹, Esra DOKUMACI ALKAN², Bilge Nur KAVALCI², Şevval ANAVATAN², Başak YAŞAR², Gizem AMMAS²**¹Hakkari University, ²Dokuz Eylul University
Türkiye

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Investigation of Microstructure of Homogenized Aluminum Alloys in The Batch Homogenization Plant and Continous Homogenization Plant**Murat DOĞAN^{1,2}, Deniz KAVRAR ÜRK^{2,3}, Büşra GEDİK^{4,5}, Gökçen GÖKÇE²**¹Yıldız Technical University, ²Sistem Teknik, ³Istanbul Technical University, ⁴Şeyh Edebalı University, ⁵Arslan Aluminum
Türkiye

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Page 215

Parametric Approach of a Novel Heat Treatment on Al-Mg-Si Alloys: Retrogression and Re-Aging**Almina DEVECİ¹, Nilgün BÖYÜKULUSOY¹, Mehmet Buğra GÜNER^{1,3}, Gökem ÖZÇELİK^{2,3}, Rıdvan GECÜ¹**¹Yıldız Technical University,
²Sakarya University of Applied Sciences, ³ASAŞ Aluminum
Türkiye

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Influence of Mg Content on The Microstructure and Mechanical Properties of EN AW 6082 Alloys**Aleyna GÜMÜŞSOY, Hilal ÇOLAK, Işık KAYA, Emrah Fahri ÖZDOĞRU**TRI Metalurji A.Ş.
Türkiye

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Session Chairman / Oturum Başkanı: **AHMET TURAN**

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Gold Extraction from Oxide Gold Ores by Glycine Leaching**Umay ÇINARLI¹, Gabriel UĞURGEL¹, M. Barış DARYAL², M. Hakan MORCALI³, Ahmet TURAN¹**¹Yeditepe University, ²Gama Composite Engineering & Products, ³Gaziantep University
Türkiye

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Page 218

An Update for Critical Raw Materials (CRMs)**Erman CAR¹, Umay ÇINARLI², Ahmet TURAN², Onuralp YÜCEL³**¹Insertec Thermal Solutions, ²Yeditepe University, ³Istanbul Technical University
Türkiye, Spain

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Page 219

Environmental Impact of Hydrometallurgical Zinc Production**Georgi PATRONOV**University of Plovdiv "Paisii Hilendarski"
Bulgaria

14.30-14.50

Page 220

Industrial Scale Extraction of Lithium Carbonate and Rare Earth Elements From Domestic Sources**Arzu S. SATILMIŞ¹, Herkail ÖZEN¹, Furkan E. ÖZEL¹, M. Şeref SÖNMEZ²**¹ASOS Process Engineering, ²Istanbul Technical University
Türkiye

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Session 4

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Fevzi YILMAZFatih Sultan Mehmet Vakıf University
Türkiye**Effect of Heat Treatment on Microstructure and Corrosion Behaviors of Additive Manufactured Ti-6Al-4V Using SLM Type 3D Printer**

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**Yusuf Atilla SADIKOĞLU¹, Şeyma KÜÇÜK¹,
Özkan GÖKÇEKAYA², Takayoshi NAKANO¹,
Hakan YILMAZER¹**¹Yıldız Technical University, ²Osaka University
Türkiye, Japan**Effect of Hf Addition on the Structural Properties, Microhardness and Oxidation Behaviour of Co-Al-W Superalloys**

15.50-16.10

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**Emre DAMAR, Mehmet Şahin ATAŞ,
Mehmet YILDIRIM**Konya Technical University
Türkiye**Homogenization of The CuNi12Zn24 Alloy Produced by Horizontal Continuous Casting**

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**Umut YILDIZ¹, Alptekin KISASÖZ², Çağlar YÜKSEL³,
Mustafa YILDIZ¹, Serdar Osman YILMAZ⁴**¹Kayalar Bakır Alaşımları, ²Kırklareli University, ³Atatürk University, ⁴Namık Kemal University
Türkiye

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Session 5

Session Chairman / Oturum Başkanı: MURAT ALKAN

16.50-17.10

Page 225**Thermodynamic and Experimental Approach of The Phase Formations in Ti-Nb-Ta-Zr-Mo High Entropy Alloys****Gökhan POLAT¹, Yunus Eren KALAY²**¹Necmettin Erbakan University,
²Middle East Technical University
Türkiye

17.10-17.30

Page 226**Integrated Processing of Al_xCoCrFeNi-Cu_a (0.5≤x≤3, a=0.5,1) High-Entropy Alloys: from Master Alloy Synthesis to Shaping****Faruk KAYA¹, Albek ERŞAN², Sajjad ALİAKBARLU¹,
Gül İpek SELİMOĞLU², Bora DERİN¹**¹Istanbul Technical University, ²Eskisehir Technical University
Türkiye

17.30-17.50

Page 227**Thermodynamic and Experimental Investigation of AlCoCrFeNiTi based High-Entropy Alloys****Murat ALKAN¹, Esra DOKUMACI ALKAN¹,
Saadet GÜLER^{1,2}**¹Dokuz Eylül University, ²Izmir Katip Celebi University
Türkiye



CWS

Corrosion and Wear Symposium

Korozyon ve Aşınma
Sempozyumu



CWS

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10.00-10.20

Page 241**Investigation of The Influence of Age Hardening on The Corrosion Resistance and Hardness of a Nanocrystalline AA2024 Alloy****Furkan ÖZDEMİR¹, Hasan OKUYUCU¹,
Rajeev GUPTA²**¹Ankara Yıldırım Beyazıt University,²North Carolina State University

Türkiye, USA

10.20-10.40

Page 242**Can High-Strength Steel Become Stainless Also with Low Chromium Content?****Beste PAYAM, Mustafa Kamil ÜRGEN, Cem ÖRNEK**

İstanbul Technical University

Türkiye

10.40-11.00

Page 245**Effect of B and Sr Addition to Trivalent Chromium Process (TCP) Coated Al-Si Cast Alloys on Corrosion Resistance****Berkay SAVAŞKAN^{1,2}, Muammer MUTLU²,
Özgül KELEŞ¹**¹İstanbul Technical University, ²MİTA Kalıp ve Dokum Sanayii

Türkiye

CWS

Session 2

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Tribocorrosion Degradation of Osteointegrated Biomedical Implants: Mechanisms, Biological Implications and (Possible) Solutions

Luis Augusto ROCHA

Digital Transformation CoLAB
Portugal

(Invited Speaker)

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Page 243

Tribocorrosion Properties of Electroless Nickel-Boron Coatings from Stabilizer-Free Bath

Muslum YUNACTI¹, Alex MONTAGNE², Mariana Henriette STAIA², Véronique VITRY¹

¹Université de Mons, ²Arts et Métiers Institute of Technology
Belgium, France



CGRS

Ceramics, Glass, Refractory Materials Symposium

Seramik, Cam, Refrakter
Malzemeleri Sempozyumu



CGRS

Session 1

Session Chairman / Oturum Başkanı: ABDULLAH ÖZTÜRK

Multi-Materials 3D Printing of Ceramics

13.30-14.00

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Lisa BIASETTO

University of Padova
Italia

(Invited Speaker)

Synthesis of Li_4SiO_4 as a Solid Sorbent for Carbon Capture via Solution Combustion Route

14.00-14.20

Page 253

**Kagan BENZESİK¹, Ahmet TURAN², Şeref SÖNMEZ¹,
Maria Teresa IZQUIERDO³, Onuralp YÜCEL¹**

¹Istanbul Technical University, ²Yeditepe University,
³Instituto de Carboquímica ICB-CSIC
Türkiye, Spain

Nb-Co co-doped Barium Titanate Dielectric Ceramics for Multilayered Ceramic Capacitors

14.40-15.00

Page 255

**Berkay ÖZGÜR¹, N. Kaan ÇALIŞKAN¹,
Abdullah ÖZTÜRK²**

¹Tübitak SAGE, ²Middle East Technical University
Türkiye

CGRS

Session 2

Session Chairman / Oturum Başkanı: ONURALP YÜCEL

15.10-15.30

Page 256

Production of Activated Carbon from Olive Seed

Derya AKBULUT, Ali Osman KURT

Sakarya University
Türkiye

15.30-15.50

Page 257

The Use of Olivine in The Production of Mineral Wool

Akın ODABAŞI¹, Gökhan BAŞMAN², Hülya KAFTELEN ODABAŞI¹, Hande ARDIÇOĞLU²

¹Firat University, ²Etikrom Inc.
Türkiye

15.50-16.10

Page 258

The Utilization of Citrate Gel Method in Cobalt Boride Synthesis

Buse BİTİKÇİ, Çağan Berker İYİ, Hülya BİÇER

Kütahya Dumlupınar University
Türkiye

CGRS

Session 3

Session Chairman / Oturum Başkanı: FİLİZ ÇINAR ŞAHİN

16.50-17.10

Page 259

Effect of Hot Isostatic Pressing on Densification, Microstructure and Electrical Properties of Mg_{0.95}Ca_{0.05}TiO₃ Ceramic

Selin GÜNTOP^{1,2}, Hakan DER¹, N. Kaan ÇALIŞKAN¹, M. Kaan PEHLİVANOĞLU¹, Abdullah ÖZTÜRK²

¹Tübitak SAGE, ²Middle East Technical University
Türkiye

17.10-17.30

Page 260

Production and Characterization of Ceramics for Microwave Applications

Melike DÖNMEZ, Cihangir DURAN

Ankara Yıldırım Beyazıt University
Türkiye

17.30-17.50

Page 261

Phase Analysis and Dielectric Characteristics of BST Ceramics Produced by Conventional and Microwave Assisted Solid-State Reactions

Başar SÜER, Özlem AYDIN ÇİVİ, Arcan F. DERİCİOĞLU

Middle East Technical University
Türkiye

17.50-18.10

Page 262

Experimental Phase Studies in The Quasi-Binary BaCeO₃-SrCeO₃ System

Hanifi Eray KORKMAZ^{1,2}, Nuri SOLAK²

¹TRMotor Power Systems, ²Istanbul Technical University
Türkiye



EMS

Energy Materials Symposium

Enerji Malzemeleri
Sempozyumu



EMS

Session 1

Session Chairman / Oturum Başkanı: BİLLUR DENİZ KARAHAN

09.40-10.00

Page 271**The Effect of Iron Concentration in Electrodeposited Solution and PH of Electrolyte on Photoelectrochemical Hydrogen Production Efficiency of Hematite (α -Fe₂O₃) Photoanode****Ersan DOĞAÇ, İlkan KARUL, Seyedsina ALYASİN, Ömer DOĞAÇ, Fatma Betül YILMAZ, Cevat SARIOĞLU**Marmara University
Türkiye

10.00-10.20

Page 272**The Thermochemical Heat Storage Properties of Composite Structures Produced Different Matrix and Sorbent Salts****Behiye YÜKSEL¹, Esra AYAN², Gökhan ORHAN²**¹Halic University, ²Istanbul University-Cerrahpasa
Türkiye

10.20-10.40

Page 273**Advanced Material Solutions for Safer and Long-Lasting High Capacity Cobalt Free Batteries for Stationary Storage Applications (CoFBAT)****Kamil Burak DERMENCİ, Kato DAEMS, Joeri Van MIERLO, Maitane BEREÇIBAR**Vrije Universiteit Brussel
Belgium

EMS

Session 2

Session Chairman / Oturum Başkanı: BURAK ÜLGÜT

10.40-11.10

Transition Metal Free: Dual Ion and Dual-Carbon Batteries

Martin WINTER

University of Münster, Helmholtz Institute Münster
Germany

(Invited Speaker)

11.10-11.30

Material Supply Risk for Thin Film Solar Cells and Importance of Recycling

Ioanna TEKNETZI, Burçak EBİN

Chalmers University of Technology
Sweden

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11.30-11.50

An Industrial Ecology Perspective of Battery Technologies for Electromobility: LCA Of Solid-State Lis Battery

Burak ŞEN¹, Ahsen AKBULUT¹, Abdulkadir KIZILASLAN¹, Mahmud TOKUR¹, Murat KÜÇÜKVAR², Nuri Cihat ONAT², Hatem AKBULUT¹

¹Sakarya University, ²Qatar University
Türkiye, Qatar

Page 275

11.50-12.10

Electrochemical Noise Measurement in Batteries with Metallic Lithium Anodes

Gözde KARAOĞLU, Burak ÜLGÜT

Bilkent University
Türkiye

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EMS

Session 3

Session Chairman / Oturum Başkanı: TUĞRUL ÇETİNKAYA

12.10-12.30

Page 277

Investigating The Electrochemical Performance of Double Shell Cathode Active Materials for Lithium Ion Batteries

Elif SARİKAS, İpek TUNC, Ozgul KELES

Istanbul Technical University
Türkiye

12.30-12.50

Page 278

Composite Electrodes Production Using Nickel-Titanium Orthodontic Waste and Investigation of Their Uses in Lithium Ion Batteries (Libs)

Humza ASHRAF¹, B. Deniz KARAHAN^{1,2}

¹Istanbul Medipol University, ²Istanbul Technical University
Türkiye

12.50-13.10

Page 279

Modulation of Cation Composition for Lithium Storage of Spinel-Structured High Entropy Oxides

**Deniz Okan BAYRAKTAR^{1,2}, Ersu LÖKÇÜ³,
Çiğdem TOPARLI¹**

¹Middle East Technical University, ²ASPILSAN Enerji,
³Eskişehir Osman Gazi University
Türkiye

13.10-13.30

Page 280

Investigation of Ni Effect on Mn-Fe-Based Multi-Transition Metal Layered Cathode Materials for Sodium-Ion Batteries

**Burcu KALYONCUOĞLU¹, Sebahat ALTUNDAĞ²,
Serdar ALTIN², Metin ÖZGÜL¹**

¹Afyon Kocatepe University, ²Inonu University
Türkiye



FAHTS

Failure Analysis and Heat Treatment Symposium

Hasar Analizi ve Isıl İşlem
Sempozyumu



FAHTS

Session 1

Session Chairman / Oturum Başkanı: UTKU İNAN

13.30-13.50

Page 289

Determination of The Austenization Temperature via Computational Metallurgy Approach for an Alloyed Ductile Iron

**Barış ÇETİN¹, Ayşe ERKAN², Ümmihan T. YILMAZ³,
Buğra ATASOY¹, Caner YALÇINER¹, Caner ŞİMŞİR^{4,5}**

¹FNSS Savunma Sistemleri, ²Döksen Isıl İşlem,
³Kırıkkale University, ⁴Middle East Technical University,
⁵Simultura Malzeme Teknolojileri
Türkiye

13.50-14.10

Page 290

The Damage Analysis of The Diamond Particle in The Cutting Natural Stone Process

Berrak BULUT

Istanbul Technical University
Türkiye

14.10-14.30

Page 291

Investigation of EPDM Materials Used in Milk Tanker

Yıldız YARALI ÖZBEK¹, Emin Emre GÖKTEPE^{1,2}

¹Sakarya University, ²Tırsan Treyler
Türkiye

14.30-14.50

Page 292

Failure Evaluation of Compression Steel Spring Wires and Factors Affecting Breaking

Y. Ziya SALIK¹, Ekrem ALTUNCU²

¹Çelik Halat ve Tel Sanayii,
²Sakarya University of Applied Sciences
Türkiye



CPS

Composite and Polymer Materials Symposium

Kompozit ve Polimer
Malzemeler Sempozyumu



CPS

Session 1

Session Chairman / Oturum Başkanı: EKREM ALTUNCU

10.00-10.20

Page 299

Surface Modification of Glass Fiber Woven Fabrics by Indium Tin Oxide Coatings and Electromagnetic Characterization of Their Multilayered Graded Composites in X-Band Frequency Range

Merve ÖZDİL DARICIOĞLU, Caner DURUCAN, Arcan F. DERİCİOĞLU

Middle East Technical University
Türkiye

10.20-10.40

Page 300

Synthesis and Characterization of Graphene Reinforced Al-7.5 wt.% Zn Matrix Composites

Berk ŞENYURT¹, Gökçe BORAND¹, Duygu AĞAOĞULLARI², Nazlı AKÇAMLI¹, Deniz UZUNSOY¹

¹Bursa Technical University, ²Istanbul Technical University
Türkiye

10.40-11.00

Page 301

Mechanical Properties of Si₃N₄ Reinforced Ti6Al4V Composite Foam

Ömür Ekrem GÜNTÜRK, Mevlüt GÜRBÜZ

Ondokuz Mayıs University
Türkiye

CPS

Session 2

Session Chairman / Oturum Başkanı: **CANER DURUCAN**

11.20-11.40

Page 302

Biodegradable Polymer Nanocomposites Using Modified Cellulose Nanocrystals**Onur Nuri ARSLAN, Yonca ALKAN GÖKSU, Mohammadreza NOFAR**Istanbul Technical University
Türkiye

12.00-12.20

Page 304

Investigation of The Effect of Copper Alloy Reinforcement on The Physical Properties of Polymer Matrix Composite**Ömer Alparslan KAYA¹, Talip ÇITRAK¹, Serdar TOZKOPARAN¹, Edanur KASAP¹, Münir TAŞDEMİR², Feriha BİROL¹**¹Sağlam Metal, ²Marmara Üniversitesi
Türkiye

12.20-12.40

Page 305

Microcellular Hemp Fibre Reinforced Polypropylene Matrix Composites**Yeşim ASLAN¹, Munir TAŞDEMİR², Yeliz ALBRECHTSEN¹, İsmail MUTLU¹**¹Tekkan Plastik, ²Marmara University
Türkiye



WNTS

Welding and Non-Destructive Testing Symposium

Kaynak ve Tahribatsız
Muayene Sempozyumu



WNTS

Session 1

Session Chairman / Oturum Başkanı: CANER BATIGÜN

13.30-14.00

Page 312

Industrial Welding Applications of S690QL Grade Steels

Tanıl ATICI

Cimtas Steel Research & Development Center
Türkiye

(Invited Speaker)

14.00-14.20

Page 313

Investigation of Microstructure and Mechanical Properties of DP Quality Steels Welded with Different Heat Inputs

**Kardelen YILMAZ¹, Bilgehan ÖGEL²,
Caner BATIGÜN²**

¹Middle East Technical University,

²METU Welding Technology and Non-Destructive Testing Centre
Türkiye

14.20-14.40

Page 314

The Effect of Process Parameters on Bead Geometry, Hardness and Microstructural Properties Armour Steel Welds Performed by Robotic Gas Metal Arc Welding

**Ceren ÇELİK¹, Recep Murat KURT¹, Ozan ÇOBAN¹,
Hakan BAYKAL², H. Kübra AKBEN¹, Uğur GÜROL^{1,2}**

¹Istanbul Gedik University, ²Gedik Welding
Türkiye

14.40-15.00

Page 315

Design of High Strength and High Torque Resistance Wire Rope

Fatih DUMAN¹, Emel TABAN², Sevim Gökçe ESEN¹

¹Çelik Halat ve Tel Sanayii A.Ş., ²Kocaeli University
Türkiye

WNTS

Session 2

Session Chairman / Oturum Başkanı: **EMEL TABAN**

15.20-15.40 Page 316	Effects of Build Orientation and Process Parameters on Mechanical Behavior of IN718 Components Manufactured by Selective Laser Melting Method Tuğçe KALELİ¹, Aydın YAĞMUR², C. Hakan GÜR¹ ¹ Middle East Technical University, ² EOS GmbH Electro Optical Systems Türkiye, Germany
15.40-16.00 Page 317	The Effect of Heat Input on Mechanical Properties of TRIP Steels in GMAW and TIG Welding Gökhan ERİAN¹, Adem KURT² ¹ Turkish Accreditation Agency, ² Gazi University Türkiye
16.00-16.20 Page 318	The Effect of Brazing Parameters on The Microstructural Features of Alumina-Copper Joints Ece Naz YURTSEVEN^{1,2}, N. Kaan ÇALIŞKAN¹, M. Kaan PEHLİVANOĞLU¹ ¹ Tübitak SAGE, ² Middle East Technical University Türkiye
16.20-16.40 Page 319	Non-Destructive Detection of Flaws in Conductive Sealant Applications With a Metamaterial Based Antenna Elif Gaye ERKİ¹, Mete BAKIR¹, Oğuzhan AKGÖL² ¹ TUSAS, ² İskenderun Technical University Türkiye
16.40-17.00 Page 320	Properties of Laser Welded 3003 Aluminum Alloy Abdullah CEBECİ¹, Emel TABAN² ¹ Assan Hanil Otomotiv, ² Kocaeli Üniversitesi Türkiye



BMS

Biomaterials Symposium

Biyomalzemeler
Sempozyumu



BMS

Session 1

Session Chairman / Oturum Başkanı: **BATUR ERCAN**

10.00-10.20

Page 323

Surface Modification of 3D-Printed Porous 316L Stainless Steel**Azade YELTEN^{1,2}, Batur ERCAN²**¹Istanbul University-Cerrahpasa,
²Middle East Technical University
Türkiye

10.20-10.40

Page 324

Characterization of Copper Nanoparticle-Deposited Bioceramic Coatings Fabricated on Zirconium**Tuba YILDIZ^{1,2}, Salih DURDU³, Kadriye OZCAN³,
Metin USTA¹**¹Gebze Technical University, ²Samsun University,
³Giresun University
Türkiye

10.40-11.00

Page 325

Production and Characterization of Bioactive Glass-Ceramics From Soda-Lime-Silica and Borosilicate Waste Glasses**Merve Şeyma SÜREL¹, İremnur AKÇAKOCA¹,
Şeniz Reyhan Kuşhan AKIN², Gülsüm TOPATEŞ¹**¹Ankara Yıldırım Beyazıt University, ²Çankaya University
Türkiye

11.00-11.20

Page 326

Essential Oil-Loaded Polymeric Foams via Green Route**Fatma Nur PARIN**Bursa Technical University
Türkiye



NMS

Nanomaterials Symposium

Nanomalzemeler
Sempozyumu



NMS

Session 1

Session Chairman / Oturum Başkanı: GÖKNUR CAMBAZ BÜKE

12.10-12.30

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Production of Nano Strontium Hexaferrite by Solution Combustion Synthesis

Ceren ÇALIŞKAN, Raşit SEZER

Karadeniz Technical University
Türkiye

12.30-12.50

Page 334

Phase Engineering of Semiconductor Nanoscale Materials

Selim DEMİRCİ, Mehmet Masun TÜNÇAY

Marmara University
Türkiye

12.50-13.10

Page 335

Effect of Starting Composition on the Morphology of Sol-Gel Synthesized Boron Carbide (B₄C) Particles

Selin TÜMKAYA, Suna AVCIOĞLU, Figen KAYA, Cengiz KAYA

Yıldız Technical University
Türkiye

13.10-13.30

Page 336

The Synthesis & Characterization of Homogenous High-Quality Graphene Encapsulated Metallic Powders via Plasma Enhanced Rotating CVD

Deniz ÇAKIR¹, Ömer Refet ÇAYLAN^{1,2}, Tarık Can TÜRKOĞLU¹, Oğulcan AKGÜN³, Günce DUGAN³, Halil Onat TUĞRUL³, Benat KOÇKAR³, Göknuur CAMBAZ BÜKE¹

¹TOBB University of Economics and Technology,

²Bilkent University, ³Hacettepe University
Türkiye

NMS

Session 2

Session Chairman / Oturum Başkanı: **M. ŞEREF SÖNMEZ**

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Page 337

New Polymorphs of Compounds With a Complex, Layered Crystal Structure Stabilized at The Nanoscale: Magnetic Strontium-Hexaferrite Nanoplatelets and Ferroelectric Bismuth-Titanate Nanowires**Darko MAKOVEC**Jožef Stefan Institute
Slovenia

(Invited Speaker)

14.30-14.50

Page 338

Production of Tin Nanowires via AAO Template Method and Investigation of Their Performance As Catalysis for Electrochemical CO₂ Reduction**Dilan ER^{1,2}, Eleni ROSOLYMOU³, Mustafa URGEN¹**¹Istanbul Technical University, ²Arcelik Global,³National Technical University of Athens

Türkiye, Greece

14.50-15.10

Page 339

The Synthesis and Characterization of MO₂CTx Mxene by Hydrothermal Etching with Different Fluoride Salts for EMI Shielding Applications**Elif OKAY¹, Ömer Refet ÇAYLAN¹,****Begüm Beril İNCECİK², Göknur CAMBAZ BÜKE¹**¹TOBB University of Economics and Technology,²Roketsan Missiles Industries

Türkiye

15.10-15.30

Page 340

Effect of Calcination Temperature on MgAl₂O₄ Nanoparticles Production by Sol-Gel Method**Duygu YEŞİLTEPE ÖZÇELİK, Sebahattin GÜRMEN**

Istanbul Technical University

Türkiye



CSS

Casting Symposium

Döküm
Sempozyumu



CSS

Session 1

Session Chairman / Oturum Başkanı: **NECİP ÜNLÜ**

15.50-16.10

Page 348

Circular Economy in Metal Foundry Sector: From Europe to Türkiye**Semih ATEŞ¹, Kerem Can DİZDAR¹,
Tunçağ Cihangir ŞEN², Serter Koray HATİPOĞLU²,
Cevat Fahir ARISOY¹**¹Istanbul Technical University, ²Turkish Foundry Association
Türkiye

16.10-16.30

Page 349

Optimizing The Amount of Flux Used in The Casting Process of EN AW 6082 Aluminum Alloy in Profile Production**Sena ERDOĞAN^{1,2}, Selçuk ERKUL¹, Zekeriya MUTLU¹,
Rabia Şevval AKAN^{2,3}, Ayberk UZER^{2,3},
Muhammet ULUDAĞ^{2,3}**¹PMS Metal Profile Aluminum, ²Bursa Technical University,
³ULUCON R&D and Consulting
Türkiye

16.30-16.50

Page 350

Reducing The Energy Costs for Green Conversion by Coating the Surfaces of the Crucibles Used in HPDC Method with Boron Reinforcement Cellulose**Ümmet AYYILDIZ^{1,2}, Songül KILINÇ^{1,3}**¹Prometal, ²Bilecik Şeyh Edebali University,
³Bursa Technical University
Türkiye

16.50-17.10

Page 351

Microstructure Evolution of The Three-Phase Al-Al₂Cu- Ag₂Al Eutectic System Upon Directional Solidification**Merve KEVKİR¹, Arash KAZAZİ²,
Samira MOHAGHEGHİ³, Melis ŞEREFOĞLU¹**¹Marmara University, ²Koç University, ³Istinye University
Türkiye



POSTER PRESENTATIONS

POSTER SUNUMLARI



Recycling and Sustainability Symposium

Geri Dönüşüm ve Sürdürülebilirlik Sempozyumu

RSS-1
Page 114

Investigation of Dissolution Conditions of Yttrium (Y) and Europium (Eu) in Fluorescent Wastes

**Utku HATİPOĞLU, Ayşegül BİLEN,
Muhlis Nezihi SARIDEDE**

Yıldız Technical University
Türkiye

RSS-2
Page 115

The Recycling Model of Zirconia & Alumina Waste in Iron - Steel Plants

Oğuzhan SAKARYA, Uğur CENGİZ

Bilecik Demir Çelik A.Ş.
Türkiye

RSS-3
Page 116

An Investigation on Calcium Aluminate Cement Production Using Two Types of Bauxite, Alumina and Marble Waste

**C. Betül EMRULLAHOĞLU ABİ, Esra ÖZGÜVEN,
Serkan KESKİN**

Afyon Kocatepe University
Türkiye

RSS-4
Page 117

Aluminium Black Dross Utilization via Pyrometallurgical and Hydrometallurgical Operations

Umay ÇINARLI, Ahmet TURAN

Yeditepe University
Türkiye

RSS-5
Page 118

Recycling of Aluminium Used Beverage Cans: Decoating and Self-Heat Generation

**Musa ORUÇ¹, Emine Bengü KAYA¹, Umay ÇINARLI²,
Tuğçe ERGÜL², Ahmet TURAN², Onuralp YÜCEL³,
Erman CAR⁴**

¹Yalova University, ²Yeditepe University,
³Istanbul Technical University, ⁴Insertec Thermal Solutions
Türkiye, Spain

RSS-6
Page 119

Circular Economy Approach for Evaluation of Mill Scale Using Al Residue as Reductant

Selçuk KAN, Kağan BENZEŞİK, Onuralp YÜCEL
Istanbul Technical University
Türkiye

RSS-7
Page 120

Lean Sustainable Green Supply Chain Management In Light Metals Casting Industry

Ümmet AYYILDIZ^{1,2}
¹Prometal, ²Bilecik Şeyh Edebali Üniversitesi
Türkiye

Aerospace Materials Symposium Havacılık Malzemeleri Sempozyumu

AMS-1
Page 133

Evaluation of Proficiency Test Results in High-Temperature Tensile Test in Aerospace Metallic Materials

**Bülent AYDEMİR¹, Hüseyin AYDIN², Fatih GÜLER²,
Aygün GÜNGÖR², İbrahim KÜÇÜKOĞUL²,
Havva KAZDAL ZEYTİN²**
¹Tübitak UME, ²Tübitak MAM
Türkiye

AMS-2
Page 134

The Effect of The Johnson Cook Damage Parameters on The Crushing Modes of an Electro-Beam Melt Additive Processed Ti6Al4V Body-Centered-Cubic Lattice Structures

**H. İrem ERTEN, Burak HIZLI, M. Arslan Bin RIAZ,
Samed ENSER, Mustafa GÜDEN**
Izmir Institute of Technology
Türkiye

AMS-3
Page 135

Influence of Platform Dimensions on The Secondary Grain Formation in Production of Single Crystal Turbine Blade

**İbrahim BERBER, Sertaç ALPTEKİN, Lütü YAKUT,
Bülent BAHADIR, Havva KAZDAL ZEYTİN**
Tübitak MAM
Türkiye

AMS-4
Page 136

Microstructural Characterization of Forged Inconel 718 Superalloy After Long Term High Temperature Exposure

**Burak HORASAN¹, İbrahim BERBER¹, Fatih GÜLER²,
Havva KAZDAL ZEYİN², Hüseyin AYDIN²**

¹Sakarya University, ²TUBITAK Marmara Research Center
Türkiye

Surface Treatment and Coating Symposium
Yüzey İşlemler ve Kaplama Sempozyumu

STCS-1
Page 151

Simulation and Fabrication of Thin Film Notch Filter

Eray HUMALI^{1,2}, M. Kürşat KAZMANLI¹

¹Istanbul Technical University, ²Roketsan Missiles Inc.
Türkiye

STCS-2
Page 152

Cone Shaped Parts Manufacturing by Electroforming Process

**Tutku TURGUTLUGİL GÖKÇE, N. Kaan ÇALIŞKAN,
M. Kaan PEHLİVANOĞLU**

Tübitak SAGE
Türkiye

STCS-3
Page 153

Tribological Performance of Electrochemically Borided AISI H13 Hot Work Die Steel

Ümmet AYYILDIZ^{1,2}, Harun MİNDİVAN²

¹Prometal R&D Center, ²Bilecik Şeyh Edebali University
Türkiye

STCS-4
Page 154

Optimization of Electroless Silver Coating on Calcium Based Ceramics

Kardelen GÜNDOĞDU, Metehan ERDOĞAN

Ankara Yıldırım Beyazıt University
Türkiye

STCS-5
Page 155

Investigation of Formation of Au-Ag-Cu Alloys by Electrodeposition from Cyanide Based Electrolyte

Berkay ÇAĞAN¹, Metehan ERDOĞAN¹, İshak KARAKAYA²

¹Yıldırım Beyazıt University, ²Middle East Technical University
Türkiye

Steel Symposium Çelik Sempozyumu

STS-1
Page 175

The Use of Boron Element for Cost Reduction in Teeth Made of Low Alloy Steel Used in Excavators

Muhammed KIRICI^{1,2}

¹Motus Automotive, ²Konya Technical University
Türkiye

STS-2
Page 176

Modelling and Simulation Studies for Optimization of Laboratory Scaled Steel Casting Mold Designs

**İ. İrfan AYHAN¹, Caner GÜNEY¹, Emre ALAN¹,
N. Başak DÜRGER¹, M. Fatih KAYADEĞİRMENİ¹,
Muhammet ULUDAĞ², Nursina ŞENSOY²,
Beyza GÜNAYDIN², Gülşah KURT²**

¹ÇEMTAŞ Çelik, ²Bursa Technical University
Türkiye

STS-3
Page 177

Development of New Steel Grade with Improved Hardenability for Renewable Energy Industry

**İ. İrfan AYHAN¹, Caner GÜNEY¹, Emre ALAN¹,
N. Başak DÜRGER¹, M. Fatih KAYADEĞİRMENİ¹,
Nazlı AKÇAMLI²**

¹ÇEMTAŞ Çelik, ²Bursa Technical University
Türkiye

STS-4
Page 178

Use Of Green Hydrogen in Iron and Steel Industry

Caner TUNA¹, Celal Erkal KAHRAMAN¹, Hakan ERÇAY¹, Tuncay DİKİCİ²

¹Özkan Demir Çelik, ²Dokuz Eylül Üniversitesi
Türkiye

STS-5
Page 179

Sinter Plant Ignition Furnace Burning Optimization

Erol AKKÜLAH, Cenk KAYA, Seyithan ÇEVİK, Mehmet AYGÜN, Bengü TAŞDELEN

Ereğli Demir ve Çelik
Türkiye

STS-6
Page 180

Efficiency Improvement via Optimizing Secondary Cooling in a Heavy-Duty Gas Turbine

Mehmet YILDIZ, Mustafa Mert ÇAKA, Cenk BAYENDER, Tansu KUKUL, Özgür AKGÜN

Ereğli Iron and Steel
Türkiye

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**Barış SAĞLAR¹, Aydan GÜLSÜREN¹, Onur OREL¹,
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**İlker AYÇİÇEK¹, Kübra AKGÜN¹, Memduh Kağan
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**Mustafa SAĞLAM¹, Esra KÜPELİ¹,
Abdurrahman Mesud ÇAKIR¹, Burcu SOYSAL ATAN¹,
Alper KURTOĞLU¹, Alperen TERZİ¹,
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⁴Kırklareli University, ⁵Ataturk University
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**İsmail Emre YILDIZ¹, Zeynep Hazal YAZĞAN¹,
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Murat ALKAN¹, Esra DOKUMACI ALKAN¹, Emre ÇİNKILIÇ²

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**Esra DOKUMACI ALKAN, Murat ALKAN,
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**M. Yeşim YALÇIN¹, A. Alkım GÖKBAYRAK¹,
C. Bora DERİN², Eda AYDOĞAN¹, Bahattin KOÇ³**

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**Emre Burak ERTUŞ¹, Çekdar Vakıf AHMETOĞLU²,
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¹KTO Karatay University, ²Izmir Institute of Technology,
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Mürüvet Hazel UYSAL, Ali Osman KURT

Sakarya University
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**Cennet YILDIRIM^{1,2}, Muhammet Nasuh ARIK¹,
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¹Boron Research Institute (TENMAK), ²Istanbul Technical University
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Emre TOY, Oğuz KARAAHMET, Buğra ÇİÇEK
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Emine ERSEZER¹, Cem AÇIKSARI², Elif ERDİNÇ², Serdar ÇELEBİ², Servet TURAN¹, Umut SAVACI¹
¹Eskisehir Technical University, ²TUPRAS R&D Center
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¹Bursa Technical University, ²Yıldız Technical University
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¹Gebze Technical University, ²Giresun University
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¹Yıldız Technical University, ²Fatih Sultan Mehmet Vakıf University
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¹KTO Karatay University, ²Necmettin Erbakan University
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Rabia Şevval AKAN^{2,3}, Ayberk UZER^{2,3},
Muhammet ULUDAĞ^{2,3}**¹PMS Metal Profile Aluminum, ²Bursa Technical University,³ULUCON R&D and Consulting
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Cemil IŞIKSAÇAN², Hatice MOLLAOĞLU ALTUNER²,
Melis ŞEREFOĞLU³**¹Koç University, ²Assan Alüminyum, ³Marmara University
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Effect of Chromium on Wear Resistance of Carbide Austempered Ductile Iron (CADi)**Barbaros SENSES¹, Ummihan T. YILMAZ², Ayse ERKAN¹, Gökhan SAĞLAM¹**¹Döksan Heat Treatment and R&D Center A.S.,²Kırıkkale University
Türkiye





ABSTRACTS

ÖZETLER





WHY DOES HUMANITY NEED NEW ENERGY MATERIALS, AND WHERE WILL WE FIND THEM?

Taylor SPARKS

The University of Utah
USA

The materials available to mankind have always been the defining factor in dictating technological advances. Humans have progressed through the stone age to the bronze, iron, steel, and silicon ages with steady improvement in the quality of life across the globe. However, as we enter the 21st century humankind also faces unique challenges. Our reliance on fossil energy has unleashed remarkable industrial progress, but at the cost of a substantial negative impact on the environment as well as unequal impacts on different sectors of society. If we are to continue to enjoy the comforts of modern technology while spreading them to developing nations and preventing adverse ecological and societal impacts, it will be imperative that we transform the ways in which we generate and store energy. This will require the discovery of new energy materials. In this talk, I will provide an overview of how materials have been discovered historically and how materials informatics is providing a radical new approach to materials discovery that can dramatically reduce the cost and time associated with materials discovery. I will discuss this in the context of several energy-related technologies including thermoelectrics, nuclear reactors, and advanced manufacturing. The talk will go beyond describing data science approaches for screening from among known materials to also include generative machine learning approaches for finding entirely new materials. Finally, I will describe ways to incorporate new resource metrics alongside performance metrics for a more complete sustainability analysis of new materials.



RSS

Recycling and Sustainability Symposium

Geri Dönüşüm
ve Sürdürülebilirlik
Sempozyumu





THE ENABLING ROLE OF MATERIALS CHEMISTRY TOWARDS NET-ZERO CARBON

R. Vasant KUMAR

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Given the massive shifts facing the future energy-environment paradigm, it is pertinent to evaluate the centrality of “Thinking” within this nexus in the evolving scenario. “Materials Chemistry”, along with many other disciplines has an important enabling role to play in the global conversation for achieving net-zero carbon transition commitments not only innovatively but also collaboratively and inclusively.

This paper will briefly consider two notable examples of scientific pathways that can make very significant contributions towards urgency of addressing “climate crisis”: (i) sustainable energy storage, advanced battery structures and environmental issues in transportation, renewable energy systems and resources; and (ii) path ahead for net-zero metal production.



INVESTIGATING THE EFFECT OF MECHANICAL PRETREATMENT ON THE RECOVERY RATE OF CRITICAL RAW MATERIALS FROM DISCARDED HARD DISC DRIVES

Alireza HABİBZADEH, Mehmet Ali KÜÇÜKER, Mertol GÖKELMA

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Waste Electrical and Electronic Equipment (WEEE) is an important secondary source of Critical Raw Materials (CRM) essential in developing novel high-tech applications. The presented study aims to track the rare earth elements, along with gold, and aluminium in the end-of-life hard disk drives (HDDs) during recycling by using two different pre-treatment procedures. The recovery rates through manual disassembly and shredded HDDs have been compared.



IRON REMOVAL FROM NDFEB WASTE MAGNET SOLUTIONS USING SODIUM ALGINATE SOLUTION

Emircan UYSAL¹, Elif EMİL KAYA^{1,2,3}, Serhat AL¹, Sebahattin GÜRMEN¹

¹Istanbul Technical University, ²RWTH Aachen University,

³Turkish-German University
Türkiye, Germany

In this study, waste NdFeB magnets were leached with sulfuric acid. Incorporation of Fe ions from the leach solution obtained, was done via using the organic molecule sodium alginate. Sodium alginate solution was prepared and mixed with the leaching solution. Fe ions constitute approximately 70.93% of the metal ions abrogated from the leach solution. The metal-alginate structures were determined by FTIR analysis.



INVESTIGATION OF DISSOLUTION PARAMETERS OF RARE EARTH ELEMENTS IN FLUORESCENT WASTES BY MICROWAVE LEACHING

Ayşegül BİLEN, Utku HATİPOĞLU, Muhlis Nezihi SARIDEDE

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Rare earth elements (REEs) are found in a wide range of high-tech products. The recovery of rare earth elements from used fluorescent lamps is important in terms of regulating the supply-demand imbalance in the market, eliminating toxic products, and making fluorescent phosphorus powder rich and cheap REE source. Microwave leaching is being studied increasingly in addition to traditional leaching methods. Because of its selective-volume heating and high heating rate, the microwave process is frequently viewed as an alternative to traditional high-temperature processes for complex materials. It is possible to dissolve minerals containing rare earth elements by this method. In this study, the metals La, Tb, and Ce collected in green and blue phosphorus powders, as well as Y and Eu found in red phosphorus powder in the waste fluorescent powder were dissolved using the microwave method. The effects of amount of solid (0.1, 0.3, and 0.5 g) in 50 ml HNO₃ and acid concentration (2, 4, 6 M) on the leaching efficiency of waste fluorescent powder were investigated. In addition, the data obtained through experimental studies were mathematically modeled with the response surface statistical design method. When the waste fluorescent powder was subjected to microwave-assisted leaching at 140°C for 60 minutes using 0.1 g of material in 6M HNO₃, the leaching efficiency of Y, Eu, Ca Tb, La and Ce metals reached their maximum values. The leaching efficiencies were 98%, 99%, 77%, 94%, 78% and 91%, respectively. Additionally, using the Response Surface Box-Behnken approach, a mathematical model has been developed. The model correlation coefficients for the concentrations of dissolved Y, Eu, Ca, Tb, La, and Ce were determined as 98.31, 99.82, 99.86, 95.33, 87.23, and 94.51, respectively.



CHARACTERIZATION AND EXTRACTION OF HEAVY METALS FROM MUNICIPAL SOLID WASTE INCINERATION FLY ASH

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This research focuses on the characterization of the fly ashes, determination of the metal species, extraction of the valuable metals, and reducing the leachability of heavy metals during landfilling. The results showed that 83 w% zinc, 100w% copper and 65w% antimony recovery is possible from the fly ash by a one stage leaching. In the case of low acidic leaching conditions, the leachate residue still contains a significant amount of leachable heavy metals which keeps the fly ash in hazardous waste classification. The heavy metal mobility are reduced after high acidic leaching conditions due to high extraction yield.



PRODUCTION OF METAL SULFIDES FROM FERROCHROME FLUE DUSTS AND INVESTIGATION OF THEIR ELECTROCHEMICAL PROPERTIES

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In the present study, flue dusts obtained from ferrochrome alloys were treated with acidic solutions. Precipitation process was conducted by using thioacetamide as sulphur source. Electrochemical properties of the produced metal sulfides were analyzed.



LI-ION BATTERY RECYCLING FOR INDUSTRIAL SCALE

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Lithium-ion batteries are the most common type of battery today. It appears in many fields from electrical-electronic devices to electric vehicles. The raw material, waste, and recycling of a product with such high usage become important. Storing lithium batteries, which are classified as hazardous waste, is also a problem. For this reason, it must be recycled. And it requires special recycling line. In this study, the process of obtaining lithium carbonate from manually decomposed electric vehicle battery and renewable energy (solar energy, wind energy) storage battery will be discussed. The amounts of metallic copper and lithium carbonate obtained from two different battery types will be covered.



RECOVERY OF END-OF-LIFE LITHIUM-ION BATTERY CATHODE MATERIALS IN ACIDIC MEDIA

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Global lithium-ion battery (LIB) market has increased due to rapid growth of electric vehicle demands and energy storage industry. Besides the advantages of LIBs such as large energy density, high efficiency, high voltage, long cycle life, low self-discharge rate and being environmentally friendly; LIBs contain several toxic chemical components to disallow storage or incineration for dispose. Also, the metals contained in the battery have an important economic impacts, metallurgical values and critical primary sources due to several reasons. In this study, 90 spent LIBs were collected and completely discharged in 1:1 CH₃COOH:H₂O solution for 24 hours. Then, components of the batteries were dismantled manually and cathode active powder striped from aluminium foil for further experiments. XRD, TG/DTA, ICP-MS analyses were carried out to characterize the cathode active powder which is the raw material of this study. The XRD pattern of the cathode powder shows the characteristic peaks of typical NMC materials (LiCo1/3Ni1/3Mn1/3O2). Leaching processes were performed in water-heated flask with 500 mL capacity with mechanical stirrer. Leaching experiments were carried out in H₂SO₄ medium in the range of 0.5-3 M concentration, 25-80°C temperature and 250 rpm for 3 hours. Samples were taken from the reactor at 5-180 minutes and the samples were analyzed by ICP-MS to calculate leaching efficiency of Li, Co, Mn and Ni. When process was completed, the solution in the flask was filtered to separate the leach residues and the solution. To investigate the leaching efficiency depending on the process parameters, ICP-MS analyses were carried out. According to ICP-MS analyses, the leaching efficiency of Li, Co, Mn and Ni, were obtained. TG/DTA and XRD analyses were performed to investigate morphological and chemical properties of the leach residue.



IS SUSTAINABILITY A PARADIGM FOR OCCUPATIONAL HEALTH AND SAFETY?

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Sustainability is simply defined as “ability of being permanent”. “Sustainability and sustainable development” is mentioned thus and so, according to description of Bruntland Commission which is approved by academy: “Sustainable development is to provide current development without taking risks for future generations’s own abilities to development needs”

Sustainability concept is consistent to current occupational health and safety(OHS) philosophy since both needs as being “proactive” in ways of doing bussiness. Risk based approach is required for current occupational health and safety, so it is mandatory for identifying and managing risks in the field. Occupational health and safety audits which are carried out in the field are accepted as the simplest “risk assessment” method. Since field operations are dynamic systems in the organizations, there is a tendency for variability momentarily. Sustainability of formal or informal occupational health and safety systems are provided by planning and implementing of periodical field audits.

Contionous improvement is needed for ensuring sustainability of occupational health and safety system. Sustainability of systems is provided by establishing a measurement system and recording of field data is mandatory for making measurement.

Recording of field data enables us to activate the results of occupational health and safety field monitoring in a standart approach. It is very important to keep recorded data and it provides inputs for our risk assessment studies. Field observations data, occupational health, vaccines, accidents/incidents, use of personal protective equipment habitual or presence of personal protective equipments must be included by recordings. All records must be accessible to all authorities. A good keeping of records enables enterprises to keep the economic impact of accidents, expenses such as lost production time, damage to machinery or raw materials, product liability at a lower level. A better evaluation for events and economical reflection results of events is made by organizations easily if they have a good record-keeping system. Thus, high risky tasks and process are detected by organization, and a prevention strtegy might be developed.

Audit, especially safety audit, is defined as “systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled”in ISO 45001 Occupational Health and Safety Management System clause 3.32. When necessity of audit is examined, the benefits below can be seen clearly:

- To evaluate the efficiency of Formal/Informal sytems or processes ,
 - Strong ways
 - Weak ways
- To create records for corporate memory,
- Audit results is evaluated as creating inputs for decision making process

Occupational health and safety audits are more complex structures when comparing with technical audits or in-site audits. In addition to ensuring compliance, OHS audits also examine the documents of the organization and determine whether the record-keeping systems’s competency. Besides, OHS audits examine the beyond of current status , training processes of the organization must be evaluated separately.



REMELTING BEHAVIOUR OF PURE AND AZ63 MAGNESIUM CHIPS

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Magnesium is widely used in many areas such as the automotive, aerospace, and medical industries. It has remarkable mechanical properties such as lightweight, strength, and creep resistance. The use of magnesium increases however the high oxidation tendency is a challenge in processing. Recycling of magnesium scraps is important due to the limited raw material accessibility, as well as environmental concerns. Magnesium is typically remelted under a salt flux (chloride and fluoride mix) which removes the surface oxides and other contaminants from the metal. This research focuses on the remelting behaviour of pure and AZ63 magnesium alloy in the form of chips. Magnesium chips were remelted under a salt flux to observe the effect of salt, temperature, and the salt factor. Fluxes with CaF_2 , MgCl_2 , KCl and NaCl were used and remelted at different temperatures (700°C, 750°C, 800°C and 850°C). Metal yield and coagulation efficiency were reported. XRD (X-ray diffraction analysis), EDX (Energy Dispersive X-Ray Analysis), and TGA (Thermogravimetric Analysis) analysis were performed for the characterization of chips and remelted samples. The melting point and density of the salt fluxes were determined by the FactSage software.



SCRAP-SALT FLUX INTERACTIONS DURING RECYCLING PROCESSES

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Due to increasing environmental and economic concerns, the recycling of metals has been increasing in the last decades. Especially aluminium is one of the most common metals, saving up to 95% of energy when recycled. Magnesium is one of the most common alloying elements in aluminium alloys, contributing to oxidation behaviour. Both aluminium and magnesium have a high oxidation tendency, and this rises the necessity of salt flux usage during remelting. Salt fluxes remove oxides and other surface contaminants from the target metal. Salt fluxes allow molten metal pieces to coagulate and form the molten bath. Furthermore, it prevents further oxidation of the metal. The presence of fluorides increases the metal yield by promoting coalescence. Although metals and salts are frequently interacting in such processes, there is still a lack of knowledge of the final and intermediate products of the interaction reactions. This study aims to contribute to the literature with metal-salt interaction trials. This study investigates the interaction of aluminium and magnesium scraps with a salt flux. The salt flux consists of KCl, NaCl, and CaF₂. 5 different scrap categories were selected which are beverage can body and lid alloy, coffee capsule, aluminium foil, and magnesium AZ63 alloy chips. Remelting under the salt flux was performed at 800°C in a chamber electric resistance furnace in a carbon crucible. Metal-salt interactions were studied under XRD (X-ray diffraction analysis), and XRF (X-ray fluorescence spectroscopy) analysis.



TIN RECOVERY FROM ELECTROLYTIC TINNING LINE (ETL) SCRAPS

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In the current study, Sn containing scraps from Toscelik tin plating plant was recovered almost completely by pyrometallurgical methods. Two different scraps were evaluated in this study. One is slag from Sn melting furnace, the second one is anode slime from tin coating. Sn slag contained around 85 wt% Sn while anode slime contained around 43 wt% Sn. These two scraps were recovered alone, and also by mixing at different ratios. At both scenario, Sn was recovered at 99% efficiency having suitable purity of use as Sn anodes.



INVESTIGATION OF DISSOLUTION CONDITIONS OF YTTRIUM (Y) AND EUROPIUM (EU) IN FLUORESCENT WASTES

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Rare earth elements (REEs) are used in a variety of applications, including electronic devices, rechargeable batteries, magnetic equipment, and optical products. In the production of REEs from ore or secondary sources, hydrometallurgical methods are preferred. One of the main secondary REE sources are waste fluorescent lamp powders. Because the phosphor powders in fluorescent lamps contain a high concentration of REE, they are excellent raw materials for recycling. In this study, the leaching with various acids was carried out to extract Y and Eu from REEs in the phosphor powders in fluorescent lamps. The effect of acid type (HNO₃, H₂SO₄, HCl), acid concentration (0.5, 1, 2, 4, 6M), H₂O₂ concentration (0.5, 2, 4M), temperature (25, 52.5, 80 °C), leaching time (30, 60, 180, 270, and 360 min), and solid/liquid ratio (1/100, 3/100, 5/100) on the leaching efficiency were investigated. The results showed that increasing the acid concentration, time, and temperature had a positive effect on leaching efficiency, whereas increasing the solid/liquid ratio had a negative effect. The highest Y extraction yield was obtained after 360 minutes of leaching at 80°C using 6M HNO₃ and a 1/100 solid/liquid ratio. Sulfuric acid gives high Y and Eu efficiency and low Ca dissolution. Therefore, it is the most suitable solvent.



THE RECYCLING MODEL OF ZIRCONIA & ALUMINA WASTE IN IRON - STEEL PLANTS

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According to the steel production data of 2021, Turkey is the 7th largest steel producer in the world and the largest steel producer in Europe. The consumption and production demand of the iron and steel industry causes the problem of raw material and energy availability. However, it creates serious opportunities in terms of demand for alternative raw materials and sustainable waste management & reduction of environmental impacts. According to the data of the Turkish Statistical Institute (TUIK), it has been stated that approximately 25,000 tons of zircon has been used in our country in 2020, and the refractory and ceramics industry has been explained as two important sectors in which the use of zircon is intense, 98% of which is imported. Zircon is a very important raw material for these two sectors in terms of high temperature and mechanical properties. In Bilecik Iron and Steel, 15,000 zirconia nozzle (~24,9 tons) waste is generated annually, approximately 3,5 tons is zirconia waste and 16,7 tons is alumina waste.

In this study, 1) minimizing the waste of the zirconia nozzles used and creating less waste, one step closer to our goal of being a green production facility, 2) ensuring the transition from the linear economy model to the circular economy model, 3) to provide raw materials to the completely imported zircon & alumina market and to contribute to the country's economy by reducing foreign dependency, 4) to expand zircon & alumina recycling or recycling activities in another field and to ensure that other companies create a recycling culture, 5) it is aimed to reduce environmental effects such as CO₂ emission, energy using and pollution of water resources, which occur as a result of the synthesis of zircon by the Kroll Method, by recycling zircon. 6) it is aimed to reduce environmental effects such as CO₂ emission, red mud, bauxite, sodium hydroxide (NaOH) energy use and pollution of water resources, which occur as a result of the synthesis of alumina with the Bayer process, by alumina recovery. In order to achieve the above-mentioned goals, firstly, the zirconia nozzle changing parameters in the continuous casting machine (CCM) were checked and new parameters were determined in order to reduce the waste at the out point.

Then, zirconia nozzle wastes were collected with a qualified waste collection approach and these wastes were categorized as alumina, zirconia and metal sheet wastes suitable for their purpose. Post-mortem analyzes were carried out for the collected zirconia & alumina wastes, and the product classes were determined and the feedback of the sector representatives was evaluated. As a result of this study, a total of \$ 195,000 financial gain was obtained from the recycled waste. In terms of the environmental aspect (Life Cycle Assessment), 113,9 tons of water, 63 MWh of energy were recovered, and 43,9 tons of carbon emissions and 35 tons red mud, 30 tons sodium hydroxide were prevented.



AN INVESTIGATION ON CALCIUM ALUMINATE CEMENT PRODUCTION USING TWO TYPES OF BAUXITE, ALUMINA AND MARBLE WASTE

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In this study, calcium aluminate cement production was investigated using two types of bauxite, calcined alumina, and marble waste. The laboratory work essentially consists of characterization of the raw and tailing materials, crushing, grinding, preparation of different recipes, heat treatment at different temperatures and finally characterization of the products by XRD analysis. The samples containing Seydişehir bauxite ore and China sinter bauxite were sintered at 1100, 1200 and 1300 °C. The mixtures containing alumina were sintered at 1250 and 1320 °C. Compositions of two types of bauxite and marble tailing having Al₂O₃: CaO molar ratio of 1:1, 2:1, 3:1, 4:1, 5:1 and 6:1 was formulated. In the products containing Seydişehir bauxite ore and sintered at 1100 and 1200 °C; the XRD patterns confirmed the presence of free CaO, C₂AS, C₁₂A₇, CA, CA₂ and Al₂O₃ phases. The higher the Al₂O₃: CaO molar ratio of the samples sintered at 1100 °C the smaller the free CaO, C₁₂A₇ and CA₂ peaks intensities while the higher the C₂AS peaks intensities. There is no important change at the peaks of CA and Al₂O₃ phases. SiO₂ content of the ore caused to C₂AS and CAS₂ formation. The higher the sintering temperatures, the higher C₂AS peaks intensities. In the products containing China sinter bauxite and sintered at 1100, 1200 and 1300 °C; the XRD patterns confirmed the presence of free CaO, C₂AS, CAS₂, CA, C₁₂A₇ and Al₂O₃ phases. The higher the Al₂O₃: CaO molar ratio, the smaller the gehlenite and free CaO peak intensities and the higher the anortite and alumina peak intensities. The higher the sintering temperatures, the higher C₂AS and Al₂O₃ peaks intensities. In the products containing Seydişehir bauxite ore and China sinter bauxite and sintered, iron element may be replaced in the atomic structure of the C₂AS and CAS₂ phases in the form of C₂(A, Fe) S and C (A, Fe) S₂. In the products containing calcined alumina and sintered at 1320 °C, the XRD patterns confirmed the presence of free CaO, CA, CA₂ and Al₂O₃ phases. The higher the Al₂O₃ %, the smaller the free CaO and CA peak intensities while the higher the CA₂ and Al₂O₃ peak intensities as expected. Since there is very small amount of silica in the materials C₂AS and CAS₂ phases were not found in sintered samples.



ALUMINIUM BLACK DROSS UTILIZATION VIA PYROMETALLURGICAL AND HYDROMETALLURGICAL OPERATIONS

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Aluminium dross has two subgroups as white dross and black dross according to metallic aluminium content. White dross is a secondary source of aluminium because of its high metallic aluminium content. However, black dross has a low metallic aluminium content (<25wt.%) and, it is usually disposed in dumping areas. In this study, it is aimed to develop a simple technique for the evaluation of aluminium black dross in the form of alumina-based ceramic materials by pyrometallurgical and hydrometallurgical processes.



RECYCLING OF ALUMINIUM USED BEVERAGE CANS: DECOATING AND SELF-HEAT GENERATION

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Aluminium used beverage can (UBC) is one of the most important resources to produce aluminium metal in upstream secondary aluminium production. Beverage cans have organic-based dye and lac layers (VOC, volatile organic compounds) which provide visual quality and protection on underlying metal. One option on UBC recycling is the application of smelting after decoating operation which is a pyrolysis at high temperatures in special furnaces. Another option is the directly smelting of UBCs without decoating operations. In the present study, self-heat formation values, which arise because of the burning of those organic layers, during the direct smelting were tried to calculate. Laboratory scale experiments were carried out with increasing smelting temperature and, TGA and DSC systems were used to measure emitted and consumed heat and weight changes during the smelting of UBCs. Furthermore, modern decoating methods were investigated in this study as well in comparison to direct smelting.



CIRCULAR ECONOMY APPROACH FOR EVALUATION OF MILL SCALE USING AL RESIDUE AS REDUCTANT

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With the increasing high production amounts in the iron-steel and aluminium industries the amount of waste and slag is increasing. In iron and steel production, iron oxide-based waste materials called mill scale are formed in the processes before hot rolling and continuous casting. In aluminum production and melting processes, aluminum is highly trapped in slag called dross. In this study, the iron in mill scale was recovered by the aluminothermic reduction method.



LEAN SUSTAINABLE GREEN SUPPLY CHAIN MANAGEMENT IN LIGHT METALS CASTING INDUSTRY

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The world continues to warm rapidly. This global warming poses a serious threat to all living things. Against this threat, 200 states came together with the Climate Change Conference under the same roof of the United Nations and aimed to take measures against this problem. In Turkey, especially as one of these 200 states, it has started awareness studies in all sectors for the problem of global warming. The casting industry is one of the sectors with high energy use and carbon emissions. Therefore, it has become important for the future of the world to create action plans for climate change in the casting industries of developing countries and to ensure positive integration into the fight. In this context, it is necessary to optimize efficiency and energy use in the realization of casting activities. We, too, take into account the sustainability commitments of our customers as part of our operational excellence and sustainability efforts. In this direction, in order to increase our production efficiency, efficiency increases are aimed with lean production methods and transition to ISO 50001 energy management model is planned. In addition, the energy points to be followed in production were determined by taking digitalization steps for the control and development of energy use and, accordingly, energy efficiency through data. In addition to all these, it is aimed to reduce carbon emissions by evaluating alternative energy methods in high electricity and natural gas use in the casting sector. State incentives are used to ensure that the machinery infrastructure is suitable for green energy as the financial resources of the studies. In order to make all these works sustainable, awareness studies are carried out by training all working teams. Awareness of green transformation has been provided in the supply chain, and the carbon footprint has been taken into account in the total quality management targets of the enterprise. Thus, in order to reduce the carbon footprint to minimum levels, integration with green transformation and the fight against climate change has been ensured by all process owners under the continuous control and supervision of the management.



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DYNAMIC RECRYSTALLIZATION IN DIRECTIONAL SOLIDIFIED CM247 LC ALLOYS

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In this study, the effects of dynamic recrystallization (DRX) on high temperature mechanical properties of directionally solidified CM247LC superalloys were investigated. Dynamic recrystallization behavior is related to hot deformation plasticity of superalloys which provides grain refinement and deformation inbittance. In this work, heat-treated CM247LC alloys were performed via interrupted creep rupture at elevated temperatures. After that, optical and electron microscopy techniques were used to examine the microstructural evaluation of CM247LC alloys.



COLD SPRAY EFFECT ON OXIDE DISPERSION STRENGTHENING OF INCONEL 718

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Oxide dispersion strengthened Inconel 718- Y, F (IN718 – Y₂O₃ – FeO – Hf), ODS In718, produced by Low Pressure Cold Spray method. The Cold Spray was conducted with He / N pressure of 8 bar, max temperature of 165-330 oC. Mechanical alloying was applied to the powders using Argon atmosphere at a rate of 300 rpm. With and without the balls 1 hour tries are conducted up to 5 hours. Stainless steel 10 mm grinding balls are used with 1 to 1 ball to powder ratio. The samples heat treated for 1,2 and 3 hours at 1050 °C. The results obtained from EDX Mapping analysis satisfied the estimated composition as well as the distribution. TEM analysis of cold spray samples showed a homogeneous distribution of nano sized Y-Ti (Hf, Zr, Al) oxides through the microstructure of obtained material. Heat treatment of the cold sprayed samples effectively decreased the porosity of the coating while producing stress relief cracks. The observations of nano oxides showed comparable results with that of selective laser melting technique.



FLOWFORMING AND HEAT TREATMENT EFFECT OF IN718 ALLOY

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The Flow-forming process has been used for several years to produce high-quality seamless, thin, and variable walled tubular components for aircraft, aerospace systems, nuclear, chemical, and petrochemical facilities, and many other major industries. IN718 alloy is often used in aviation industry and it is important to form and harden this material. The aim of this study is to analyze the effect of solution heat treatment and subsequently the Flow-forming process. Microstructure analysis by optical microscope and SEM and hardness measurements were applied to the initial preform manufactured in accordance with the AMS5662 standard, after solution heat treatment at 1066 °C/1h of the initial preform and after Flow-forming process of the solution heat treated part.



A NUMERICAL ANALYSIS OF THE EFFECT OF ELECTRO-BEAM-MELT Ti6Al4V COVER PLATE ON THE BALLISTIC PERFORMANCE OF SiC ARMOR

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Various cover plates, including high strength 4340, RHA alloys and ductile Al and Cu metals manufactured using conventional manufacturing methods, were numerically and experimentally investigated previously as cover plates in ceramic armors. This study, on the other side, focused on the use of an Electro-Beam-Melt processed Ti6Al4V alloy as a cover plate in the SiC ceramic armors. The use of Electro-Beam-Melt processed Ti6Al4V alloy was shown to increase the ballistic limit of SiC ceramic, showing a potential of application in ceramic armors. An optimization of the thickness of the cover plate was however needed in order to not to increase the weight of the armor significantly.



EFFECT OF SOLUTION HEAT TREATMENT ON THE ANISOTROPY OF MICROSTRUCTURE, TEXTURE AND MECHANICAL PROPERTIES OF HASTELLOY X FABRICATED BY LASER POWDER BED FUSION

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In the present study, the effect of building direction and solution heat treatment on the microstructure, crystallographic texture and mechanical properties of Hastelloy X (HX) alloy fabricated by laser powder bed fusion (LPBF) method was investigated. The tensile test results revealed that vertically built samples showed higher ultimate tensile strength (UTS) value of 145 MPa with lower ductility than that of the horizontally built samples. Solution heat treatment caused a decrease in strength values while the ductility of both samples significantly enhanced by 62% and 32.8% for the vertically and horizontally built samples, respectively.



EFFECTS OF HEAT TREATMENT AND HOT ISOSTATIC PRESSING ON HIGH TEMPERATURE MECHANICAL PROPERTIES OF Ti-48Al-2Cr-2Nb ALLOY PRODUCED BY ELECTRON BEAM MELTING

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In this study, Ti-48Al-2Cr-2Nb samples were produced by electron beam melting (EBM) method. Mechanical properties of as-built γ -TiAl produced by EBM significantly differ from those of the parts produced by conventional methods due to several issues including microstructural instabilities, porosity and residual stresses. Therefore, a subsequent heat treatment was found to be vital to eliminate those issues generated from the nature of the EBM layered process. The Ti-48Al-2Cr-2Nb alloy typically contains two main phases, γ -TiAl as the matrix and α_2 -Ti₃Al with various morphologies depending on the type of the processing and heat treatment history. The present study was conducted to characterize the microstructure and high temperature tensile strength behavior of EBM manufactured Ti-48Al-2Cr-2Nb samples in the as-built, heat-treated and hot isostatic pressed (HIP'ed) conditions within the purpose of utilizing this alloy for structural aerospace applications.



THE EFFECT OF POWDER BED FUSION AND DIRECT DEPOSITION METHODS ON METALLIC MATERIALS

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The current study brings an understanding of microstructure of metallic materials, e.g., stainless and Inconel 718 alloy. The general characteristics of Inconel 718 and stainless steel, fabricated using powder bed fusion and directed energy deposition methods, were investigated in this study. The main purpose of the current study is to reveal differences in fabrication of metallic materials such as Stainless Steel and Inconel 718 alloy using recent additive manufacturing methods. The variances in grain and sub-grain morphologies, such as size and shape, has been detected due to heat source and processing based thermal effects which are important for the resultant properties of the final product.



MATERIALS FOR EXTREME ENVIRONMENTS: ON THE OUTSIDE LOOKING IN

Ali SAYİR

Air Force Office of Scientific Research
USA

Aerospace Materials for Extreme Environments program of Air Force Office of Scientific Research aims to provide the fundamental knowledge required to enable revolutionary advances. Extreme environments are combination of heat-, stress-, magnetic-, optical-, electric-, microwave-, and acoustic fields. This presentation will focus on specific materials challenges. As a program manager, one is on the outside looking in because research has been accomplished by the principal investigators. Subset of research concentration areas are selected from AFOSR funded research to highlight the philosophy about function, environment and state of the materials that could create disruptive source of transformations. These areas include but are not limited to predictive materials science, electro mechanical coupling with the structure and losses, non linear optical materials, electro-optical coupling, materials, ultra wide band gap β -Ga₂O₃, goniopolar materials, and materials for quantum information science.



EVALUATION OF PROFICIENCY TEST RESULTS IN FATIGUE TEST IN AEROSPACE METALLIC MATERIALS

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An accredited test laboratory must take the proficiency test (PT) to ensure the reliability of its results. It is defined in TS EN ISO/IEC 17025, TS EN ISO/IEC 17043 standards, and TÜRKAK documents within the studies that need to be done to ensure the validity of results.

In this study, samples from the Inconel material used in the aerospace industry of the same specification are prepared according to the ASTM E606 standard. Test samples after a specific numbering have been sent to the participating labs. Each laboratory has applied a fatigue test to samples according to the method described in the ASTM E606 standard. The test results are reported accordingly. All results have been evaluated by TÜBİTAK UME Force Laboratory. The evaluation of the proficiency test results was made in accordance with the TS EN ISO / IEC 17043 standard and the results were presented.



MECHANICAL BEHAVIOR OF REPAIRED CARBON FIBER REINFORCED POLYMER COMPOSITE LAMINATES

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Türkiye

This study investigated the on-site repairs of carbon fiber reinforced polymer (CFRP) composites. As such repairs involve out-of-autoclave curing, the process takes place at atmospheric pressure and at relatively lower temperatures. As a result, the defect density tends to be higher, which reduces the mechanical properties. This work aims to investigate the relationships between the repair parameters and the mechanical response, providing data for the effective repair of critical aerospace components.



MICROSTRUCTURAL EVOLUTION OF CMSX-4 SLS SINGLE CRYSTAL SUPERALLOYS DURING CREEP RUPTURE TESTS

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In the present study, microstructural evolution of standard heat treated CMSX-4 SLS single crystal (SX) superalloy was investigated in different creep conditions via various temperature & stress conditions. To obtain a better understanding for the relationship between microstructure and creep properties of these alloys, samples were standard heat treated (HT) and then thermo-mechanically deformed by creep rupture (CR) tests. Creep tests were applied through with different temperature and stress conditions; at 982°C/221 MPa and at 871°C/620 MPa. Microstructural characterizations were done using with optical and electron microscopy techniques both on HT and CR samples. The investigations were focused on the variation of morphology, volume distribution and size of the γ and γ' phases. Due to different creep conditions, heat treated microstructures evolved similar to the service conditions. As a result, ongoing transformation mechanism of the γ and γ' phases in the matrix was examined via creep tests and a model was tried to suggested.



EVALUATION OF PROFICIENCY TEST RESULTS IN HIGH-TEMPERATURE TENSILE TEST IN AEROSPACE METALLIC MATERIALS

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Test laboratories must verify test procedures and test capabilities for reliable results. Inter-laboratory comparisons (ILC) and proficiency tests (PT) are important tools for evaluating the technical competencies of calibration and test laboratories. This is detailed in the TS EN ISO/IEC 17025, TS EN ISO/IEC 17043 standards, and TURKAK documents. It is a requirement sought by TURKAK that accredited laboratories, or laboratories applying for accreditation, participate in the PT program and/or the ILCs related to tests in the accreditation scope and have achieved successful results.

In this study, samples from superalloy material used in the aerospace industry of the same specification were prepared according to the ISO 6892-2 standard. Test samples after a specific numbering have been sent to the participating labs. Each laboratory performed a tensile test on samples according to the method described in the ISO 6892-2 standard. The test results have been reported by participating laboratories according to the procedures described in the relevant standards. TÜBİTAK UME Force Laboratory there is a reporter laboratory where all the results are evaluated. Evaluation of qualification test conditions, test devices, and results shall be given in detail the calculations carried out in accordance with the TS EN ISO/IEC 17043 standard.



THE EFFECT OF THE JOHNSON COOK DAMAGE PARAMETERS ON THE CRUSHING MODES OF AN ELECTRO-BEAM MELT ADDITIVE PROCESSED Ti6Al4V BODY-CENTERED-CUBIC LATTICE STRUCTURES

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Additively manufactured titanium alloys show an impressive energy absorption capacity and high specific mechanical strength. Variation in Johnson Cook damage parameters are quite effective for the crushing modes occurring in the compression simulation of electron-beam-melt (EBM) Ti6Al4V (Ti64) Body-Centered-Cubic lattices (BCC). In this study, the effects of these damage parameters were analyzed numerically and their convergence to the experimentally obtained crushing modes was investigated. Cells having 125 units with 10 mm size, 2 mm strut diameter and 2 mm face sheet thickness were fabricated for this particular study. After the lattice structures were subjected to the experimental compression test, they were simulated using the Johnson Cook damage model in the LS-DYNA program. The optimum value was obtained by comparing the crushing modes of the experimental samples and the numerical lattice models with different initial failure strains (D1).



INFLUENCE OF PLATFORM DIMENSIONS ON THE SECONDARY GRAIN FORMATION IN PRODUCTION OF SINGLE CRYSTAL TURBINE BLADE

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Tübitak MAM
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In this study, the relationship between the CMSX-4 single crystal turbine blade superalloy to be produced and the secondary grain defect that will occur on the platform surface when the turbine blade platform size parameters are changed is investigated. For this purpose, by determining the appropriate thermal gradient and withdrawal rate, solidification was carried out in the Vacuum Induction Melting (VIM) furnace with the Bridgman Method. Consequently, platforms of different sizes were created and their microstructures were analyzed.



MICROSTRUCTURAL CHARACTERIZATION OF FORGED INCONEL 718 SUPERALLOY AFTER LONG TERM HIGH TEMPERATURE EXPOSURE

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The aim of this study is to investigate the microstructure and mechanical evaluation of Inconel 718 superalloy after long thermal cycle oxidations. Inconel 718 superalloy, produced by triple melting, was deformed by radial forging at high temperatures and subjected to heat treatment. Thermal cycle tests carried out to examine the thermal stability of materials that will operate in service conditions similar to gas turbine conditions. Microstructural and mechanical characterizations were performed to provide the evaluation of $\gamma \rightarrow \gamma', \gamma''$ formation after a long service of thermal cycle test.



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ZnO NANOWIRE GROWTH VIA ANODIZATION

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ZnO nanowires having three different sizes (70 ± 8 nm, 97 ± 7 nm and 140 ± 9 nm) were obtained via anodization. The effect of ZnO nanowire diameter on their antibacterial properties was assessed with both gram-negative *Escherichia coli* (E. coli) and gram-positive *Staphylococcus aureus* (S. aureus) bacteria. In addition, the effect of ZnO nanowires on bone cell proliferation was investigated in vitro. Our results showed that ZnO nanowire diameters could be controlled in the nanoscale by optimizing anodization parameters, and this, in turn, simultaneously enhanced antibacterial and biological properties of ZnO nanowires.



PRODUCTION AND CHARACTERIZATION OF GOLD NANOFILMS ON TRANSPARENT SUBSTANCES BY ELECTRODEPOSITION METHOD

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In this study, deposition of gold nano films on indium tin oxide (ito)- coated glasses by pulse current electrodeposition method was examined. The gold nanofilms obtained on ito-coated glasses were characterized by focused-ion beam, thin film X-ray diffraction, scanning electron microscope, optical transmittance measurements and atomic force microscope.



EFFECT OF SUBSTRATE BIAS ON MECHANICAL PROPERTIES OF MAGNETRON SPUTTERED AlTiN-B₄C FILMS

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The primary objective of this research was to investigate the mechanical and tribological properties of AlTiN-B₄C hard coatings deposited by magnetron sputtering physical vapor deposition (PVD) method by employing different substrate bias voltages. In the present study, a pulsed dc magnetron sputtering PVD system was adopted to prepare AlTiN-B₄C coatings. The deposition was done on the Si wafers, AISI 304 SS and AISI 1.3343 M2 grade high speed steel substrates. Al_{0.67}Ti_{0.33} and B₄C were used as target sources for deposition. The chemical states in the coatings was observed through XPS analysis. Phase formations were detected by XRD. The surface morphology and the thickness of all the coatings were investigated by FE-SEM analysis. The hardness and Young's modulus were measured via nanoindentation test. Tribological behaviors of the coatings were examined by ball-on-disc tribometer at room temperature against Al₂O₃ ball. Overall, experimental results indicate that the changing the substrate bias voltage has an important effect on the structural, and morphological properties but there is no obvious effect on mechanical properties of AlTiN-B₄C coatings.



EFFECT OF MICRO ARC OXIDATION AND PRECIPITATION HARDENING ON THE CORROSION RESISTANCE OF 7075 AL ALLOY FABRICATED BY FLOW FORMING

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Flow forming is a cold deformation process to produce precision tubes for automotive and aerospace applications. During flow forming, the grains elongate along the deformation direction, and strength of the material increases due to strain hardening. Flow formed parts may work in corrosive environments during service. As it is a cold forming process, it may reduce the corrosion resistance of the formed parts, and hence improved corrosion resistance is required.

In this study, effect of various precipitation hardening conditions and micro arc oxidation (MAO) coating on the corrosion resistance of a flow formed Al 7075 alloy tube were investigated. Deformation ratio during the flow forming was 55% in terms of the thickness reduction of the tube. The MAO process was applied by using a bipolar DC power supply in an aqueous electrolyte solution. Immersion corrosion tests were conducted in 3.5 wt.% NaCl solution up to four weeks. The surface and cross sections of the coatings were examined by a scanning electron microscope (SEM), and the coating phases were identified by an X-ray diffraction (XRD) analysis. Electrical conductivity and hardness measurements were carried out to monitor the ageing effect on the microstructure of the samples. The results were evaluated to compare the corrosion resistance of the bare and the coated alloys with that of the untreated alloy.



CARBON-BASED PVD COATING SOLUTIONS FOR A SUSTAINABLE FUTURE

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Automotive and other transport industries have been traditionally based on combustion engines. During the same time, there has always been a permanent demand for increasing of both the efficiency and durability of the combustion engine. Among many technology improvements in this direction, reduction of wear and decreasing of friction have been constantly in focus. PVD carbon-based coatings applied to many of the engine components, such as camshafts, crankshafts, tappets, fuel nozzles and others, have proven to lead to decreased fuel consumption, thus moving the industry to more sustainable levels. In the past decade, the transition from classical combustion to electrical and hydrogen-based engines is paving its way with an increasing speed. This brings new demands and requirements for the engine components. For example, the efficacy of the hydrogen fuel cells is highly dependent on the corrosion resistivity of its stack of plates from one hand and its conductivity from other one. Whilst a noble metal, such as gold, can satisfy this requirement, its price makes the solution economically non-viable. Here, however, carbon-based PVD coatings can provide excellent solution for sustainable future on economically acceptable price.

In this talk, a retrospect of the carbon-based PVD coatings and the technologies for their deposition are discussed from an industrial perspective. State-of-the-art performance of the coatings in real conditions is given. Next to it, the choice of a specific coating and the most suitable technology for its deposition on a specific application is outlined.



EFFECT OF ALUMINIZING ON THE HIGH TEMPERATURE OXIDATION BEHAVIOR OF INCONEL 718 SUPERALLOY

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This study was undertaken to investigate the effect of aluminizing on the high temperature oxidation behavior of Inconel 718 nickel based superalloy. Bare and high activity chemical vapor deposition (CVD) aluminized Inconel 718 samples were oxidized in air at 925, 1000 and 1050°C for 200 hours. Detailed cross-sectional examinations, elemental analyses, weight change measurements, and x-ray diffraction studies were performed in order to investigate and evaluate the oxidation mechanisms of the samples. At 925°C it was observed that the oxidation resistance of Inconel 718 alloy was significantly improved by the protective Al₂O₃ layer formed on the NiAl phase that was created on the surfaces of the samples during aluminizing. The NiAl phase, on the hand, did not survive at higher test temperatures and therefore the beneficial effect of aluminizing started to decrease.



IMPROVING FRACTURE TOUGHNESS OF ALTiN HARD COATINGS BY W ADDITIONS

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Hard coatings are widely utilized in the machining industry to increase the lifetime of cutting tools and allow higher cutting speeds. One of the primary drawbacks of conventional metal nitride hard coatings is their brittle nature. This study aimed at improving the fracture toughness of the coatings to overcome this problem. Our approach was to explore refractory elements additions to conventional ALTiN coatings, based on density functional theory predictions in the literature. The results showed that W additions can dramatically improve the fracture toughness.



PERFORMANCE AND WEAR OF VACUUM BRAZED DIAMOND CUTTING TOOLS WITH REINFORCED ELECTROLYSIS COATING

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Synthetic diamond has been commonly used as abrasives of grinding or cutting tools. Traditional diamond tools mainly include sintered diamond tools and electroplated diamond tools. Active brazing has been recently recognized as a technique that offers high bonding strength of brazed diamond grits, and hence high protrusion and large chip storage space of abrasive tools. Active elements (Ti and Cr) are usually added to the alloy filler to make the active alloy that can braze the diamond. The high melting points of Ni-Cr alloys lead to high brazing temperatures typically above 1000 °C. During high-temperature brazing, C atoms from diamond grits are dissolved in liquid Ni, which could exaggerate the formation of graphite or amorphous C and impair the mechanical integrity of brazed diamond grits. Extensive research effort has been made to develop brazing strategies and methods in order to reduce the thermal damage of brazed diamond. In this study, the combination of the active brazing and electrolysis process was investigated. The benefit of the electrolysis process is creating a cooling layer on the diamond cutting tools for improving the hardness and wear resistance. With this methodology, the disadvantages of the nickel in active brazing will be eliminated and at the same time the cutting performance-enhancing property of nickel will be utilized. Microstructures of the samples were determined by Scanning Electron Microscopy (SEM) and Xray Diffraction (XRD) analysis. In order to examine the mechanical properties of the coatings, their hardness was measured by indentation method, micro-scratch analyzes and the wear tests were carried out. The trace formed as a result of the micro-scratch test was examined under an optical microscope and SEM. In the wear tests, natural stone was used as abrasive. No water was used during the test, and the resistance of the coating against heating was observed. Results showed the active brazing-electrolysis treated samples have high mechanical properties than active brazing samples. In the absence of the electrolysis layer, shape deformation occurred in the samples due to heating and the service life was lower than the samples with the electrolysis layer.



FOR MORE SUSTAINABLE COLD FORGING PROCESS: USE OF SAND BLASTING INSTEAD OF PICKLING AND RINSING

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Due to increasing environmental awareness and energy costs, alternative production methods have gained importance for the sake of sustainable manufacturing. In this study, use of sand blasting instead of pickling and rinsing was examined. Process parameters namely blasting time and blasting rate were investigated for metal wires with 8.0 mm diameter. Surface roughness and hardness measurements were carried out to characterize the effect of process parameters. Polymer-based coating was applied to sand blasted-surfaces and surface roughness measurements were repeated. Extrusion tests were conducted for final performance evaluations. In addition, a comparison was made between sand blasting and pickling and rinsing with respect to sustainable manufacturing. It was revealed that sand blasting offered less water and chemical agents usage compared to pickling and rinsing. Moreover, production efficiency was higher for sand blasting process.



INVESTIGATION OF MECHANICAL AND CORROSION PROPERTIES OF ELECTROLESS Ni-W-Co-SiC MULTICOMPONENT COATINGS

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Electroless nickel coatings are widely used in the defense and aerospace industry due to their superior properties such as high wear resistance, high hardness, corrosion resistance and homogeneous coating on the part surface. In this study, it was aimed to develop multicomponent electroless nickel coatings with good mechanical properties and high corrosion resistance under high temperature. There are many studies on multicomponent nickel coatings in the literature, whereas there is limited number of studies, in which tungsten, cobalt and/or silicon carbide has been used by using different types of complexing agents and reducers. In this study, 32CrMoV12-10 discs were used as substrate. Tungsten, cobalt and/or silicon carbide were added to electroless nickel plating bath with different reducers and complexing agents. The morphology of the coated surface will be investigated by using different techniques, also the composition and structure of the coating will be determined, microhardness tests and coating thickness measurements will be done. The corrosion properties of the coating will be described chemically.



SOL-GEL SPRAY COATING OF ALUMINIUM ALLOYS FOR THE AUTOMOTIVE APPLICATIONS

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In the automotive industry, light-weight alloy usage has been increased due to provide weight loss and thus fuel efficiency. Some of the aluminium alloys, especially the 5xxx and 6xxx series are utilized for the production of car bodies and decorative parts in the automotive industry [1]. However, the corrosion resistance of the bare alloys doesn't comply with the respective standards.



WEAR AND CORROSION PERFORMANCE EVALUATION OF LASER CLADED BRAKE DISC

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Investigations about both carbon-inducing brake discs and other related parts of automobiles are significant and necessary in terms of new regulations to reduce non-exhausted emissions coming into force day by day, and able to meet green expectations from the new-generation automobiles. Gray cast iron-based brake discs are safety and economical parts that are exposed to high wear and corrosion in the face of increasing vehicle speeds and road conditions. Disc life and brake performance are reduced due to varying harsh weather and aggressive road conditions. Trends and developments in electric vehicles; weight reduction, higher wear and corrosion resistance, lower replacement costs, minimum brake dust are desired without loss of brake performance on the new generation brake discs. Therefore, advanced surface treatment or coating applications on brake discs are an inevitable necessity for new generation vehicles.

In this study, the martensitic stainless steel used as a coating material is developed mainly to satisfy the property requirements for hardness, high strength, wear resistance, and corrosion resistance. Then pad-disc friction properties and the brake performance were measured in bench test at different temperatures. Test results are given comparatively. In addition, corrosion resistance performance for red rust occurrence was evaluated by performing salt spray test.



A COMPARATIVE STUDY ON CORROSION PROPERTIES OF DECORATIVE CHROMIUM AND PVD EVAPORATED ALUMINIUM COATED ABS PARTS

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In this study, the corrosion behavior of coating which decorative chromium (Cr) and PVD (Physical Vapor Deposition) evaporation aluminum (Al) on Acrylonitrile butadiene styrene (ABS) furniture parts were comprised. The corrosion analysis was carried out with visual examination and electrochemical analysis. As a result, the decorative Cr is more resistant to dipped and electrochemical corrosion in contrast these analyses, PVD evaporated Al is more resistive in the salt spray test.



SIMULATION AND FABRICATION OF THIN FILM NOTCH FILTER

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Notch filters, a type of interference filter, block a narrow band on the electromagnetic spectrum. They are used in various fields such as in the defense industry, medicine, and Raman spectrometers. The filtering band of notch filters can be controlled by tuning their two cut-off frequencies. In thin films, controlling the filtering behaviour is possible to control the film materials and thickness of the thin-film layers. The dispersion phenomenon is the one of most outstanding parameters that influence the refractive index of the film materials. In this study, the Sellmeier dispersion equation of the selected film materials was used to create a mathematical model for thin-film notch filters. According to the results of the model, various thin-film notch filters which are composed of pre-determined film material combinations, were produced using the electron beam (E-beam) evaporation technique. The mathematical model and optical analysis results of the filters were compared to each other, and the effect of the material combination, film thickness, and the number of film layers on filtering performance was investigated.



CONE SHAPED PARTS MANUFACTURING BY ELECTROFORMING PROCESS

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Tübitak SAGE
Türkiye

In this work, cone shaped copper parts manufacturing with electroforming method is studied. The effects of electroforming parameters such as solution concentration and pH, the stirring rate of the solution, the filtration state of anode material, pulsed forward to reverse current ratio, on the product properties such as grain size and surface uniformity and total production time are examined. Experiments had shown that, filtering the anode with silk aided in increasing the surface uniformity and refining microstructure of the cone shaped part. Increasing the HCl concentration from 0.05 ml/l to 0.1 ml/l, and hence varying the pH between 0.15-2, accelerated the electroforming process, but degraded the surface uniformity. Pulsed forward to reverse current ratio was found to be an important parameter in terms of shortening the process time and properties of the obtained product. As far as the results of this study is concerned, using an acid copper sulphate solution with additive of HCl concentration 0.05 ml, oxygen free copper anodes with filtration and pulsed forward and to reverse current ratio of 3 were the optimum parameters for cone shaped copper electroform parts.



TRIBOLOGICAL PERFORMANCE OF ELECTROCHEMICALLY BORIDED AISI H13 HOT WORK DIE STEEL

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DIN 1.2344 (AISI H13) steel was treated using electrochemically boriding with the intention of prevention unexpected die failure in hot metal forming. The treatment process was carried out in a molten salt based on 90 % borax ($\text{Na}_2\text{B}_4\text{O}_7$) and 10 % sodium carbonate (Na_2CO_3) at a constant temperature of 950°C for 15 min and a current density of 200 mA/cm² in a stable and then soaking it in the melt (applied current having been terminated) for an additional 45 min. The steel test pieces were attached to the cathode holder of the electrolytic boriding cell while a graphite crucible served as the anode. The boride layer thickness, composition, and structural morphology were investigated using light optical microscopy (LOM) and X-ray diffraction (XRD) methods. The mechanical and tribological behaviors were assessed using microhardness and reciprocating wear tests, respectively. The thickness of the layer formed in the AISI H13 steel borided at 950 °C for ~60 min was about 25 µm. The composition of borided layer is composed of FeB and Fe₂B phases having 1800 ± 50 HV0.5 hardness. The composite layer consisting of FeB+Fe₂B displayed up to less wear 99 % and also lower coefficient of friction in comparison with untreated AISI H13 steel working in relative motions. This study showed that electrochemical boriding of die steels is feasible, and this method can be considered as a viable alternative to producing hard and protective layers on AISI H13 steel by other techniques.



OPTIMIZATION OF ELECTROLESS SILVER COATING ON CALCIUM BASED CERAMICS

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Coating technology has been carried out with the aim of reducing corrosion and surface friction, and also providing conductivity and aesthetic benefits. Silver plating is preferred due to its high electrical properties, thermal conductivity and low melting temperature. It can be carried out with or without the need for external electrical current. However, it is possible to make the homogeneous coating on metallic or non-metallic materials that do not have a smooth geometry with electroless silver plating. This study aimed to make the catalytically inactive materials electrically conductive by electroless silver plating. Conductive ceramics have many application areas. Dielectric oxide ceramics have been utilized as filters and oscillators within the microwave wireless communication industry. In this context, parameter optimization will be made that provides appropriate coating thickness, homogeneity, and adhesion properties to measure relative permittivity and dielectric loss of resonator ceramics.



INVESTIGATION OF FORMATION OF Au-Ag-Cu ALLOYS BY ELECTRODEPOSITION FROM CYANIDE BASED ELECTROLYTE

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Ternary Au-Ag-Cu alloys have multifunctional properties, such as high electrical conductivity, corrosion and wear resistance. Because of these properties, they are used in slip rings, which are crucial for electromechanical systems used mainly in aerospace, naval, and land defense systems or medical devices. In this study, static potential and cyclic voltammetry measurements were carried out to determine the appropriate amount of potassium cyanide and the reduction potentials of gold, silver and copper in gold-silver-copper cyanide solutions. The effects of applied voltage and bath composition on the produced alloy composition were studied. Electrodeposited layers were characterized by scanning electron microscopy (SEM) and X-ray fluorescence (XRF) to take cognizance about surface morphology, coating thickness and alloy compositions.



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EVALUATION OF CHROMITE ORES BY METALLOTHERMIC PROCESS IN EAF

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In this study, reducing smelting of chromite concentrates by EAF assisted metallothermic method; the effect of AlPowder and AlDross addition amount, time and the ratio of flux addition on the produced metal and slag compositions and metal recovery were investigated. As a result, it was seen that ferrochrome can be produced from fine-grained chromite concentrate by this method. At the end of EAF assisted semi-pilot smelting experiments using aluminum as reductant, the highest chromium content in produced alloys was 59.52 wt. %, while the highest chromium recovery from chromite concentrate to alloys was 76.73 wt. % in these experiments.



DETERMINING OPTIMUM ROASTING CONDITIONS OF HEMATITE MAGNETIZATION WITH TEMPERATURE-COKE MIXTURE COPULA

**Zeynep Hazal YAZĞAN¹, Mikail BAŞYİĞİT¹, Abdullah BUHUR²,
Elif UZUN KART¹**

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In this study, the magnetization behavior of Türkiye's volcanic kafa ore (VKO) was investigated with reduction roasting. The Kafa ore contains mainly hematite which is the main source of iron along with a small amount of goethite and gangue minerals namely quartz and calcite. Since it is necessary to separate the gangue from iron-bearing ore and low magnetic susceptibility of hematite; the magnetization of hematite was carried out by reduction roasting. By doing so, it was aimed to separate the magnetized iron ore from the gangue by magnetic separation. In order to achieve this purpose, an experimental design was planned which has 5 different sets of temperature and 3 different sets of coke mixture ratios. The temperature ranges from 400 °C to 900 °C by 100 °C increment in every set. Similarly, the coke that was used as a reducing agent mixture, takes values of 30, 40, and 50%. Following the experimental setup, roasted VKOs were subjected to low-intensity dry magnetic separation at 750 oersteds magnetic field strength. The effects of temperature and amount of coke on the transformation of hematite to magnetite and the determination of mineralization of the concentrate obtained after magnetic separation were investigated by X-ray diffraction. Fe grade and recovery were determined by using chemical analysis, and then the optimization of the experiments was determined with Fe% recovery that was obtained after magnetic separation. X-ray diffraction patterns show that magnetite transformation begins at 600 °C after reduction roasting. After magnetic separation, the effect of the temperature and the effect of the coke mixture on Fe% recovery were investigated. The relationship between Fe% recovery and temperature was shown as a linear correlation. The recovery rate can be expressed as $y = 0.2114x - 77,711$ where y is the recovery rate and x is the temperature. The fitness of the model is very high with an $R^2 = 0.886$. However, the effect of the coke mixture on Fe% recovery could not be detected. The fitness of the model confirms this indifference by $R^2 = 0.0078$. When the coke mixture was kept constant, iron recovery efficiencies were lower than 57% till 600 °C and it sharply increased by temperature and peaked at 800 °C. A peculiar condition was detected at 700 °C and a 50% coke mixture with a 90% Fe-recovery rate. Another high-efficiency point was observed at 800 °C and a 30% coke mixture with an 89% Fe-recovery. In conclusion, two optimal conditions were found with different trade-offs. The first one requires a lower temperature while needs more coke. The second condition needs more temperature while the coke requirement is lower than the first one. These conditions can be traded regarding the following conditions: availability of energy, cost of marginal temperature increment, availability of coke, and cost of coke.



EFFECT OF LADLE FRUNACE SLAG ON STEEL CLEANLINESS OF TIRECORD STEEL IN ISDEMİR PLANT

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Cord wire steel, which is one of the group of tire reinforcement steels, is a steel grade with high steel cleanliness and the control of the inclusion morphology in the production processes must be carefully managed. Elements such as steel cleanliness, mechanical results and microstructure, which are the expectations of the customer in cord wire production, are among the main points to be considered. Cleanliness of tire cord steel is important due to the usage area of the cord wire. The cold drawing of the cord wire to very thin diameters (<0.18 mm) makes the inclusion types that will occur in the steel important as well as the cleanliness of the steel. It is critical that the inclusions of the Alumina type, which cannot be formed especially for the cold drawing process, remain at a very low level in the steel. Basically, ladle metallurgical slag has a significant impact for determining the type of inclusion in the steel. It is known in the literature that tire cord wire is produced with slag compositions with a slag basicity value of 0.6-1.5 and the desired inclusion type can only be achieved at these basicity values.

In this study, the effects of slag basicity on steel cleanliness and inclusion types in steel were investigated while tire cord wire production was carried out at Isdemir facilities. Basically, the differences between heats produced with low basic value, which is thought to be suitable for tire cord wire production, and heats made with classical basic slag composition, in terms of steel cleanliness and inclusion type are emphasized. In the heats made for the tire cord wire, it is ensured that the basicity of the slag remains at a maximum value of 1.5. In the heats produced with basic slag and intended to be used in the production of bead wire, the values remained between 2.2-3.0. In both productions, soft stirring times were kept long in order to have a positive effect on steel cleanliness in the ladle metallurgy process. Flotation, which was done for 20-25 minutes in the production of tire cord wire, was made in 15 minutes in the production of bead wire. After the study, the steel cleanliness samples were examined with the Explorer 4 equipment. This device counts inclusions with the logic of scanning electron microscope and reports on the chemical composition, morphology, distribution and size of the inclusions. When the results were inspected, the inclusion composition of the steel produced in accordance with the production of tire cord wire was examined. It was observed that the Al_2O_3 type inclusions investigated in low levels. Hence it is interpreted that the final sample meets the requirements for tirecord steel. When the chemical composition of the steel grade for the bead wire is examined, it contains inclusions with high Ca-Al composition similar to the heats produced with classical basic slag.



SYNTHESIS OF NANOCRYSTALLINE STAINLESS STEELS BY MECHANICAL ALLOYING: GRAIN GROWTH, PHASE TRANSFORMATION, THERMAL STABILITY AND MECHANICAL PROPERTIES

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Nanocrystalline stainless steels often display a large grain size dependent improvements in mechanical properties as predicted by the Hall-Petch relationship. On the other hand, their production and wider structural and engineering applications may be limited by the high driving force for thermally induced grain growth even at low temperatures. Accordingly, thermal stability of nanostructured stainless steels is crucial for successful consolidation via powder processing routes and for high temperature structural applications. Here, recent research on grain size stability and hardness properties of nanostructured stainless steels are reported. Nanocrystalline austenitic stainless steels with solute additions were synthesized using high energy mechanical alloying. Structural and microstructural characterizations were carried out using x-ray diffraction (XRD) techniques and focused ion beam microscopy (FIB) as a function of solute additions. The dependence of hardness on the microstructure was utilized to study the mechanical changes. The relative importance of solute additions was discussed with respect to grain size stability, phase stability, and hardness after annealing at 1100 °C.



DESIGN AND INVESTIGATION OF THE MECHANICAL PROPERTIES OF LIGHT ALLOYS FOR ELECTRIC VEHICLES

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New generation alternative fuel vehicles are an important development for urban public transportation in the international arena. In electric vehicles, the current number of passengers and vehicle range are negatively affected by the weight of the power supply, compared to conventional vehicles. With the lighter vehicles, the maximum number of passengers permitted will be reached and the range of the vehicle will increase.

The reduction in vehicle weight will provide technoeconomic benefits by paving the way for the use of batteries, engines and similar equipment with lower capacity. The most important component for electric vehicles used in the transportation sector is the battery and the place where the battery will be located. The roof structure of the electric bus, where the battery is placed, has been redesigned with using HSLA steel and 6063-T5 aluminum alloys, in order to reduce the vehicle weight.

The materials to be used in the roof structure have been selected in the most appropriate way characterized by testing and structural analysis. The results showed that the number of passengers increased by 4 people, the roof structure has nearly the same strength as the design with no batteries installed and overall vehicle endurance limits were not exceeded.



COIL SLUMPING IN PERITECTIC STEELS

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Coil slumping can be observed after coiling or stock. This defect is a shape problem in hot strip mills. The coil slumping defect can be metallurgically associated with phase transformation, unsuitable tension and stacking conditions in peritectic steels. Defective coils are sent to the recoiling line for requested diameter. Recoiling line can be affect additional cost, ready-to-ship product tonnage and coil's final quality. In this study, The probability of slumping defect was modeled using the binary logistic regression analysis method. Experiments were made by determining the factors affecting the probability of slumping defect and the levels of these factors. In 1.6050_40 Isdemir order quality, approximately %90 improvement was achieved by changing process temperatures and run out table practices in collapse rate.



REDUCING QUALITY COST BY REDUCING TRANSVERSE SURFACE CRACK DEFECT IN SLAB GRADES

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In Isdemir, an integrated iron and steel producer, liquid raw iron comes out of blast furnaces, passes through different facilities which are respectively desulfurization, basic oxygen furnace (converter), ladle furnaces and continuous slab casting plant and finally becomes semi-finished product “slab”. Cracks that occur transversely on the slab wide surface are called “Transverse Surface Crack”. The transverse surface crack is difficult to detect at the end of the continuous slab casting plant and can be detected after the scarf process or after the slab has cooled. In this study, peritectic grades and relatively high carbon grades should be charged above 300 OC in the reheating furnaces. 4237, 4252, 4250 and 3032 grades have been investigated in this research. Isdemir 4237 grade belongs to the EN 10025-2:2019 standard and is included in the hot rolled non-alloy structural steels group. Isdemir 4252-4050 peritectic grade belongs to the S355JR-J2 standard and is in the high strength structural steels group. Isdemir 3032 grade belongs to the EN 10083-2:2006 standard and is included in the hot rolled carbon steel group suitable for ring manufacturing after rolling and heat treatment. Data sets have been inspected according to 2021 production results of studied grades. Heat fluxes, Secondary cooling, superheat temperature, and chemical analyzes have been imported to data sets. The probability of transverse surface crack defect on the prepared data set was modeled through the Minitab program with the binary logistic regression analysis method. Factors that were found to be statistically effective were also evaluated from a metallurgical point of view in the light of process knowledge. As a result of the analyzes a trial procedure was established and the cost of quality caused by the transverse surface crack defect was reduced.



INVESTIGATION OF MICROSTRUCTURAL PROPERTIES OF FISH SCALE RESISTANT LOW CARBON ENAMEL STEEL GRADES

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Enamel coated steels are widely used in high-temperature equipment, white goods, silos, water tanks chemical reactors, etc. thanks to their good formability, weldability and enameling behavior. Since these steel grades are susceptible to the fish-scale formation, microstructure of these materials needs to be specially designed. Fish scale is caused by excess hydrogen that dissolves into the steel during the enamel firing process. As expected, steel sheet production steps make some differences in the microstructure of the steel. In this study, the effect of two steps of production, cold rolling and annealing, on hydrogen permeability was investigated. It was observed that the hydrogen permeability properties are improved by decreasing the grain size of ferrite and increasing the area fraction of precipitates that are trapping sites for hydrogen atoms.



THE ROLE OF THERMOMECHANICAL ROLLING IN PETROLEUM PIPE STEELS AND ITS EFFECTS ON MECHANICAL PROPERTIES

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Thermomechanical rolling (TM) have a great importance in obtaining mechanical properties depending on the usage area of the product. It is a rolling method that is frequently used to obtain high strength, hardness and toughness values in low carbon and micro alloy steels. With the thermomechanical rolling process, it tries to change the microstructure by performing both mechanical treatment and heat treatment on the coil. In this study, the mechanical properties and microstructure changes of microalloyed steels after thermomechanical rolling were investigated. Chemical composition, microstructure, thermo-mechanical controlled process (TMP) metallurgical information is shared in order to achieve the targeted strength, ductility and toughness properties in different qualities and especially EN ISO 3183:2019 Annex A PSL2 L485ME quality petroleum pipe steels.



EFFECT OF ISOTHERMAL TRANSFORMATION ON MICROSTRUCTURAL AND MECHANICAL PROPERTIES OF A LOW CARBON MICROALLOYED BAINITIC FORGING STEEL

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Bainitic forging steels have been developed as an alternative to Quench and Temper (Q&T) steels in recent decades due to their lower cost and energy needs, as well as their superior combination of strength, ductility, and toughness. The mechanical properties and fatigue performance of bainitic steels surpass those of their alternatives and with microalloying the mechanical properties, such as yield strength and ultimate tensile strength are further improved. Although the effect of continuous cooling on bainitic forging steels without microalloying has been investigated, the influence microalloying and isothermal transformation on the microstructure and mechanical characteristics of these steels remains to be investigated. For this purpose, a low carbon microalloyed bainitic forging steel (0.2C-1.3Si-1.5Mn-1.45(Cr+Mo), microalloyed with V-Ti-Nb) is isothermally transformed at a temperature just above M_s , 360 °C, for various isothermal holding times. The isothermal transformation routes are simulated by JMatPro[®] software, and the transformed steel is experimentally investigated by means of optical microscopy and scanning electron microscopy examinations, and mechanically characterized by hardness tests and tensile tests. In addition, XRD measurements are used for determination of retained austenite content. The results show that prolonged holding time does not have a significant effect on retained austenite content and hardness values are similar across various isothermal holding times. The mechanical tests show that a high ductility (>10%) and high strength (>1200 MPa) steel was obtained.



EXPERIMENTAL INVESTIGATION AND THEORETICAL EXPRESSION OF THE EFFECT OF STEEL WIRE ROPE PARAMETERS ON BREAKING LOAD

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Steel wire ropes are critical carrying elements working under load used in a wide range of applications and various industries made of strands twisted around the core and many wires forming strands. Steel wire ropes are produced with appropriate designs and features to fulfil the expected performance according to the usage area and loading types. There is a minimum breaking load value, which is theoretically calculated with a formula determined by ISO 2408 standard, which is one of these performance properties and which steel wire ropes must provide. According to the existing conditions, the determination of the rope behaviour is only possible by experimentation. The scope of the study is the expression in terms of coefficients of the effects of the steel wire rope parameters on the breaking load. In this study, a suitable design of experiment was created to reveal the effects of the steel wire rope parameters; which are rope lay length ratio, preform ratio in percentage and rope grade in kg/mm² on the breaking load. Experimental and statistical data obtained by tensile tests by the ISO 6892-1 standard of steel wire ropes produced following the experimental design are determined and presented.



THERMODYNAMIC INVESTIGATION OF KAPPA-CARBIDE PHASE CHANGE IN LOW-DENSITY STEELS

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Low-density steels are classified as steel grades with high entropy/low-density steels with Fe-Mn-Al-C basic alloying elements. Low-density steels with high Al content, developed since the early 1950s, are evaluated in the automotive industry, cryogenic applications and aerospace fields.

Kappa-carbide phases are one of the crucial structures in low density steels in austenite matrix. In this study, it is investigated that the change in as-cast structure depends on alloy design. Manganese, which is one of the alloying elements, triggers the main phase to be austenite in steel, while Al acts as a ferrite stabilizer. It has been determined that Kappa-carbide formation tends to transition to coarse structure at the grain boundaries as the Al content increases. In order to obtain as-cast structure with high equiaxed ratio, ingot mold casting was carried out in an air induction furnace and homogeneous cooling conditions (thermal insulation, exothermic casting feeder powder, etc.) were applied to the ingot. The activity of the Kappa-carbide phase and its relationship with Al, Mn and the oxygen activity of the liquid steel was evaluated, hereby the metallurgically ideal alloy design was achieved by using some thermodynamic software tool.



THE MODELING OF MECHANICAL PROPERTIES OF LOW-CARBON GRADE (SAE J403:2014 1006, SAE J403:2014 1008, SAE J403:2014 1010) WIRE ROD STEELS

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600.000 tons wire rod are produced in İskenderun Demir ve Çelik Inc. Co. (İSDEMİR) annually in 2020. In wire rod mill production are divided according to application of wire rod that are wire, high carbon, pin bolt, bolt and welding wire in the range of $\bar{A}$ 5,5 and $\bar{A}$ 16 mm diameter. 15 % of total production is SAE J403:2014 1006, SAE J403:2014 1008, SAE J403:2014 1010 grades. İskenderun Iron and Steel Inc. (İSDEMİR) grades 1.1006_00, 1.1008_00 ve 1.1010_00, which belongs to SAE J403:2014; they are the class of carbon steels carbon steels for wire drawing manufacturing. In the study, experiments were made with different cooling rates and modeling was done with regression analysis. As a result of the experiments and analysis obtained with the experimental design, a mathematical model was obtained that explains the tensile strength at the rate of 66,6%. The optimum levels of the input factors were determined in line with the mathematical model obtained. When the production results are examined, an improvement of 49.4% in the standard deviation value of the tensile strength values in 1.1006_00 grade, 29.4% in 1.1008_00 grade and 50.2% in 1.1010_00 grade compared to previous productions.



MODELLING OF MONOBLOCK LOADS BY QUALITY BASED PROCESS PARAMETERS TO ENSURE OPTIMUM PRODUCTION SPEED AT WIRE ROD MILL

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Türkiye

600.000 tons wire rod are produced in İskenderun Demir ve Çelik Inc. Co. (İS-DEMİR) annually in 2021. In wire rod mill production are divided according to application of wire rod that are wire, high carbon, pin bolt, bolt and welding wire in the range of $\bar{A} \sim 5,5$ and $\bar{A} \sim 16$ mm diameter. 130-130 mm billets pass through roughing mill, 1st intermediate mill and 2nd intermediate mill and monoblock and reach the final diameter. Both of rolling speed, vibration and load are related to each other. The vibration level of block stand is always monitored and when the vibration level is high, rolling speed is decreased to control the vibration. Due to the higher block loads and vibration level during the production of high carbon&-low carbon steel qualities carried out in 2021, the rolling speed was lower than normal. In this study, the factors that affect monoblock loads of 5,5 mm diameter high carbon and low carbon steel quality are determined by CART analysis and multiple linear regression method and optimum rolling speed has been obtained. The total wire rod production of these steel qualities increased due to the increase in the rolling speed.



REDUCTION OF EMISSIONS WHILE REMOVING DUST FROM ISDEMIR NEW BLAST FURNACE DUST CATCHER

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İskenderun Iron and Steel Co. Inc. (ISDEMİR) New Blast Furnace No.1 will be commissioned as Turkey's largest blast furnace with a working volume of 3072 m³ and a daily production capacity of 7900 tons of liquid raw iron. It is important for the environment and process safety to keep the byproducts of this blast furnace, which has a large production capacity, under control. One of the outputs of the blast furnace is blast furnace gas. The gas, which comes under pressure to the dust catcher system, first hits an impact surface and spills some of the coarse dust it contains with the effect of gravity. At the same time, due to the shape of the dust trap, the pressurized blast furnace gas creates a vortex inside and leaves more dust. At the same time due to the shape of the dust trap, the pressurized blast furnace gas creates a vortex inside and leaves more dust. Blast furnace gas, which is a dirty gas, comes out as semi-dirty gas from the dust catcher and is cleaned by the other equipment of the gas cleaning system. It is very important for process safety to regularly discharge the dust left by the blast furnace gas to the dust catcher. While these dusts are being discharged, controlled irrigation is carried out by means of nozzles in order to minimize dust emission to the environment. In general applications, these dusts are taken into the truck bed. In ISDEMİR New Blast Furnace No.1, these powders will be taken to the bulk trailer as an alternative. In this way, minimum emission and minimum environmental pollution are foreseen and dust catcher design is made in this way. In this study, it will be explained how the dust emission is prevented and how it contributes to the environment and the blast furnace process with the improvements made in the design of the dust catcher system in the ISDEMİR New Blast Furnace No.1.



UNDERSTANDING CARBON DIOXIDE EMISSIONS IN ELECTRIC ARC FURNACE OPERATIONS

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Direct emissions result from the reaction of carbon-containing fuels and raw materials with oxygen. Carbon dioxide emission amounts can be increased or decreased significantly with effective process management and raw materials used in the process. The carbon-oxygen balance in the EAF and how to maintain this balance for more efficient use of chemical energy are the factors that need to be known to reduce direct carbon dioxide emissions. This study focuses on discussing the improvement of CO₂-emitting reactions in EAF processes.



EMISSIONS OCCURING IN THE COOKING PROCESS IN STEEL MANUFACTURING AND METHODS OF STRUGGLE AGAINST EMISSIONS

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Steel is the most widely used metal in the world, which is frequently used in the fields of construction and engineering, forms the basis of the industrial economy. The large amount of CO₂ released into the atmosphere during steel production is one of the most important factors causing global warming. For this reason, the role of steel in the climate crisis has been closely examined in recent years, as in the petroleum and coal sector. In the steel production process, liquid raw iron, scrap and other alloying elements are converted into liquid steel by pure oxygen blowing method. For the production of liquid raw iron, iron ore, sinter, pellets and coke are used as inputs. Coke, which is used as the most important input, is obtained by charging the coal carried by conveyor belts to battery ovens and burning in high temperature and oxygen-free environment. During the coking process, environmental polluting emissions occur at many different points. Some of these emissions can be discharged from the general chimneys connected to the batteries or they can be mixed into the air with different sources during various activities. In addition to fugitive emissions from the general chimney, emissions from ovens, oven doors and flanges occur. These emissions, which occur for various reasons, include dust, CO, volatile organic compounds, hydrocarbons, sulfur compounds, aromatic hydrocarbons and heavy metals such as mercury. The amount and types of emissions that occur vary according to each point. The global iron and steel industry accounts for 11% of carbon emissions and 7% of greenhouse gas emissions. According to the Paris Agreement, carbon emissions in the industry are aimed to reach zero between 2050 and 2070. In this context, priority is given to struggle against emissions in iron and steel production, and related studies are continuing. Dust collection systems are one of the most important parameters in emission control methods. In these systems, fugitive emissions are controlled by using the bag filter method. Apart from dust collection systems, the damage to the environment is minimized by struggle against emissions with many different methods. Temperature measurements are taken at certain intervals in battery ovens, and cleaning is done along the heating lines in ovens with low temperatures. The refractory team continues to work on oven doors, charging covers and damaged oven walls with daily routine controls. In this study, the emissions that occur in the coking process during steel production at the İskenderun Iron and Steel Factory (İSDEMİR) and the methods of struggle against emissions are discussed.



DECARBONIZATION AND GREEN STEEL PRODUCTION IN IRON AND STEEL INDUSTRY

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Decarbonization and green energy production are very important in Iron-Steel industry which has high level of carbon emissions. In this scope, one of the important things that could be done is usage of renewable energy sources. Green Deal, announced by the Council of the European Union, exposes the importance of the green energy and decarbonization for the future. For the Iron-Steel industry which has a wide industrial and employment capacity, green steel production should be carried into action as quickly as possible. The decrease in petroleum reserves in the world as a result of excessive use and consequently the increase of its price furthermore the damage it has caused to the environment have made us do a research on alternative fuels that are abundant in nature and environment friendly. The enormous damage to the environment caused by exhaust emissions from fossil fuels used in internal combustion engines has led countries to take precautions in this regard. Studies show that hydrogen, which is abundant in the universe, has many of the required properties for a fuel. Hydrogen is potentially available wherever there is water and clean power source. It has more efficient combustion feature compared to the other fuel types. Since hydrogen does not contain carbon and sulfur, there is no CO, CO₂ and HC among the combustion products. Theoretically, water is the only substance formed when hydrogen is burned. We can easily say that hydrogen has many advantages in many aspects ecologically. The fact that hydrogen, which is a secondary energy source, can be obtained with different and renewable primary energy sources, is considered to make this fuel type the most important energy carrier of the future. In addition, hydrogen can be used with the other fossil fuels. With this feature it provides many advantages. These are:

1. Reduced NO_x and CO emissions and increased thermal efficiency as a result of lowering the fuel/air mixture limit
2. Reduction of the pressure differences between cycles
3. Increasing the flame speed of the mixture"



THE USE OF BORON ELEMENT FOR COST REDUCTION IN TEETH MADE OF LOW ALLOY STEEL USED IN EXCAVATORS

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The effects on the mechanical properties by reducing expensive alloying elements and adding boron (0.003-0.005 wt %) to alloy for excavator teeth were investigated. The study concluded that: the tensile strength of modified alloy was found to be 1757 ± 24 MPa, yield strength 1613 ± 29 MPa, % elongation value of 3. The amount of energy absorbed by the sample was found to be 27 ± 3 joules. Hardness measurements were made from the outside to the inside of a thick section of the tooth. While the hardness on the surface (under decarburized structure) was 51 HRC, the value of 47 ± 2 HRC was also obtained in the innermost region.



MODELLING AND SIMULATION STUDIES FOR OPTIMIZATION OF LABORATORY SCALED STEEL CASTING MOLD DESIGNS

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In this study, NovaCast software was used to determine the optimum mold design for steel casting applications with using laboratory scaled vacuum induction melting unit. The shrinkage volume of final products was compared that were produced via gravity die casting method with different mold designs. High strength low alloy steel was melted and cast while the permanent mold material was selected as cast iron. It was shown that shrinkage cavity is an unavoidable result for top-open vertical mold design. Additionally, the high amount of open and closed porosities in solidified steel for vertical mold designs were observed due to high turbulent flow of liquid steel while pouring directly into the mold cavity. Therefore, the mold design was optimized with adding a slope with different angle of gradients in order to reduce the turbulence effect. Furthermore, a neckdown typed exothermic sleeve was integrated to top of the mold to act as a pouring basin and a feeder. The mold with optimized design was physically produced and the trial productions were performed with laboratory scaled melting unit. The macro and microstructural investigations of solidified steel cast resulted with relatively lower amount of shrinkage cavity and porosities as estimated via casting software.



DEVELOPMENT OF NEW STEEL GRADE WITH IMPROVED HARDENABILITY FOR RENEWABLE ENERGY INDUSTRY

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In the near future, wind power is expected to be one of the most popular renewable energy sources. A rapid growth is also expected in the need of steel material with higher mechanical properties with a variety of sectional thicknesses by the increasing demand in wind power industry. Therefore, new alternative steel grades with higher hardenability will offer a solution to fulfill the need of material with desired properties. In this study, new alloying strategies were investigated in order to provide higher mechanical properties including hardenability as well as strength and toughness. The new steel alloys were designed by using computational thermodynamic software and laboratory scaled productions were performed with the selected chemical compositions. The mechanical test results showed that the required conditions for bolt and fasteners according to ISO 898-1 standard can be achieved by proper optimization in the alloying strategies.



USE OF GREEN HYDROGEN IN IRON AND STEEL INDUSTRY

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Energy; is an important factor affecting environmental pollution, quality of life, national economy, and international relations. Due to the increasing population in the world, the increase in energy demand and energy costs, environmental pollution caused by consumed fossil fuels, and global climate change bring renewable energy to the fore. The iron and steel industry contributes negatively to the CO₂ emissions in the world in general, and in this context, it continues to operate as one of the important factors of climate change. Nowadays, a number of working technologies related to the production of hydrogen and hydrogen-enriched reduction technologies are widely carried out in the blast furnace and direct reduced iron process.



SINTER PLANT IGNITION FURNACE BURNING OPTIMIZATION

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Bengü TAŞDELEN**

Ereğli Demir ve Çelik
Türkiye

In this study, in Ereğli Demir ve Çelik Fabrikaları T.A.Ş. (ERDEMİR) Sinter Plant, the applications are made to optimize and improve the ignition furnace temperature and to determine the minimum furnace temperature that will not lose combustion efficiency, to save coke oven gas and reduce dust and CO₂ emissions, working automatically according to the furnace temperature determined for ideal combustion and monitoring the parameters related to the coke oven gas on the Level 1 screens are discussed.



EFFICIENCY IMPROVEMENT VIA OPTIMIZING SECONDARY COOLING IN A HEAVY-DUTY GAS TURBINE

**Mehmet YILDIZ, Mustafa Mert ÇAKA, Cenk BAYENDER,
Tansu KUKUL, Özgür AKGÜN**

Ereğli Iron and Steel
Türkiye

In this study, heavy-duty gas turbines located in integrated iron and steel plants named Ereğli Demir ve Çelik Fabrikaları T.A.Ş. (ERDEMİR) efficiency increasing and power regaining by optimizing secondary cooling air somehow adjusting cooling fans working regime and increasing cooling air amount using external air source results evaluated in statistical data analysis will be explained.



INCREASING HOT ROLLED MILL PRODUCTION BY INCREASING COIL WEIGHTS UNDER 1,80 MM THICKNESS

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Türkiye

One of the most important parameters affecting production efficiency in hot rolled mill production is coil weight. Coil weight is calculated by slab length, thickness, width, density, slab to coil transition efficiency calculations. In İsdemir, slab thickness is 225 mm and it cannot be changed because of fixed casting mold is used. On the other hand, slab width cannot go beyond certain options depending on the opening and crushing situations in the hot rolling mill. The only parameter that can be optimized in coil weight is the slab length, since the yield calculation is not very variable and the density also varies according to the amount of some alloy and a constant density value is assumed. Each slab length below 12,000 mm reduces the production speed of the rolling mill and negatively affects many areas such as the number of samples, slab furnace fuel consumption, manipulation and packaging. Coils with a thickness of less than 1.80 mm were produced with a slab length max. 10,500 mm. In this study, the slab length has been gradually increased for coils with a thickness of less than 1.80 mm, considering and analyzing various factors such as order steel quality, customer, thickness, width, rolling process values and coil slumping risk. Thus, the production rate and production amount of hot rolled products increased, the number of truck transfers, slab furnace emissions, scrap amount and the number of manipulations were reduced, and also contributing to the carbon footprint positively.



THE EVALUATION POTENTIAL OF BASIC OXYGEN FURNACE (BOF) SLAG AND THE RECYCLING OF CALCIUM CARBONATE BY HYDROMETALLURGICAL METHODS

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Türkiye

Steelwork slag is one of the waste material groups obtained from İsdemir basic oxygen furnace (BOF) facilities. Their chemical compositions and properties vary according to the produced quality and production conditions. Slag is obtained in the steelmaking process, during the purification of molten iron from impurities. Various researches are carried out for the use of steel slag in different industrial facilities. One of the most important factors in determining the usability of steelwork slag as raw material in different production areas is the economic contribution of the process. Today, a large part of the slag is used or discarded without fully exploiting its properties. In this study, the general usage areas and potential sectors of the steel mill slags and recovery conditions of high purity calcium carbonate by injection of carbon dioxide into the leach solution in which Ca^{2+} ions were selectively extracted from the basic oxygen furnace (bof) slag of İsdemir by using acetic acid were studied.



ESTIMATING TAP HOLE CLAY CONSUMPTION IN BLAST FURNACE BY FUZZY LOGIC METHOD

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Türkiye

Liquid hot metal (LHM) and slag are produced as a result of the reaction of the ferrous materials and coke charged in the blast furnace (BF) with the hot blast blown from the tuyere located at the bottom of the furnace and accumulates in the BF hearth. For the drainage of the LHM and slag accumulated in the hearth, the cast opening process is performed with a specially designed drill. After the LHM and slag drainage in the hearth is completed, the refractory-based taphole clay filled into the specially designed mud gun equipment is injected into the tap hole and the tap close process is carried out. Another task of the taphole clay is to ensure the formation of mushroom around the taphole at the hearth. Thanks to the mushroom thus formed, BF contributes to the prolongation of the hearth life by minimizing the wear of the carbon blocks around the hearth during LHM and slag drainage. The consumption of the taphole clay varies depending on the working conditions and taphole length of the BF, and the taphole clay quality. On the other hand, under ideal conditions, the use of taphole clay from the taphole is an important factor in terms of cost and life of the BF hearth. In this study; Studies have been carried out on the estimation of the consumption of the taphole clay to be used in, by fuzzy logic method, depending on the taphole length, %Si value in LHM and slag arrival times. By applying the rules obtained by the fuzzy logic system on the Level 2 expert system, Taphole Clay Consumption Model was developed, which gives a taphole clay consumption recommendation in each tap.



COMPARISON OF MANGANESE OXIDE (MnO) AND IRON OXIDE (FeO) ANALYZES IN STEEL PRODUCTION SLAG WITH DIFFERENT ANALYSIS METHODS

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Türkiye

Characterization of by-products is important in primary and secondary production facilities in steelmaking processes. The chemical and mineralogical determination of the output by-products (slag of the steel production process) has been evaluated within the scope of this study. The content of converter (BOF) slags consists of phases such as calcium oxide, magnesium oxide, manganese oxide in basic oxide structure, and silicon dioxide and iron oxides in acidic oxide structure. Converter slag is generally in the form of Fe₂O₃ and Fe₃O₄. It has been determined that the general structure of ladle furnace (LF) slags is in the form of calcium aluminate, the total value of the minor phases such as FeO and MnO is high in the converter slag analysis, and these values are lower in the ladle furnace slag [1-2]. MnO and FeO becomes difficult in the processes where the final product is approached. The aim of the studies is to determine how the minor phase distribution changes with which process data, especially in ladle furnace slags.



WATER MANAGEMENT IN IRON AND STEEL INDUSTRY

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Türkiye

The impact of climate change on water resources results in changes in the hydrological cycle and changes in water quality. Although the total amount of water in the world remains constant with the hydrological cycle, changes in the precipitation regime negatively affect the amount and quality of surface and underground water resources. Although water is one of the most important inputs in the Iron and Steel industry, production cannot be made without water, and it is one of the sectors with high water consumption. At İskenderun Iron and Steel (İSDEMİR), water management is given the utmost importance as it is aware of the importance of water for both nature and production. Although the principle of 'we cannot manage what we cannot measure' has been adopted in the management of water, measuring water is the basis. In total, measurement values are taken from 167 different points. These values can be monitored instantly on the PIMS (Plant Information Management System) installed in our factory and are reported daily, monthly and weekly in the ENYS (Energy Management System) through which these data flow. With established systematics, increases in consumption points and places in need of improvement throughout the factory are determined. The circulation rate of the facilities and the water consumption per production of the factory are monitored within the annual targets and necessary actions are taken in case of target deviations. In addition, İSDEMİR's water footprint calculations were made in 2021 and action items were determined.



THE EFFECT OF MAINTENANCE ACTIVITIES ON ENVIRONMENTAL MANAGEMENT IN IRON AND STEEL FACILITIES

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Türkiye

As in every production facility, all systems and machines are expected to operate at the desired level in a sustainable, reliable and efficient manner in the integrated iron and steel production line. Achieving this situation is possible with an effective asset management. Asset management is a very complex structure provided with the participation of many organizations and individuals. Moreover, it interacts with other management tools. In this study, the relationship between asset management and environmental management will be discussed.



MANAGEMENT OF FERROALLOYS STOCKS IN IRON AND STEEL PRODUCTION

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Türkiye

The Planning and Coordination Unit of Production Planning Department in Iskenderun Iron and Steel Company (ISDEMİR) aims to keep stocks at optimum level by communicating with sales, raw materials, purchasing, inventory, quality and operating departments and making ferroalloy consumption estimates. In this direction, material consumption forecasts are obtained by loading data from the models created on Level 4 systems in ISDEMİR into the system. Model outputs are evaluated with inventories and data is provided to the supply chain. With this way, ferroalloy stocks are kept at optimal stock levels and inventory costs are minimized. The fact that iron and steel prices are global is important in terms of increasing the competitiveness of our company with this study.



INVESTIGATION OF CASTABILITY OF DIN EN 10089 38Si7 STEEL GRADE IN BILLET CASTING MACHINE

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İsdemir is an integrated steel producer and the process route follows blast furnace, desulfurization, basic oxygen furnace (converter), ladle furnaces and continuous billet casting plant respectively. After casting, steel becomes semi-finished billet for wire rod rolling. In this study, it is investigated that the castability of 38Si7 steel grade in billet continuous casting plant. The usage area of this grade, which has high silicon content, is rail and fasteners. 38Si7 grade is produced according to DIN EN 10089 standard. During the casting of 38Si7 grade, clogging problems and level fluctuations are observed. Hence, number of heats in tundish was lower than other submerged casted grades and interruption of heat during casting was relatively high. In the preliminary studies, a data set was created with parameters such as stopper levels, chemical analysis, alloying elements, slag-former materials, calcium treatment process and casting time with clogging problems. The parameters that cause clogging in the nozzle were restricted at certain values and the deoxidation practice was revised. Finally, the average number of heats taken in the tundish has increased and level fluctuation problem has resolved at end of the studies.



PRESSURE VESSEL DETECTION SYSTEM WITH IMAGE PROCESSING TECHNIQUES

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Türkiye

From time to time, a pressure vessel may be included in the scraps loaded into scrap box in the steel-making a scrap preparation facility. Human ingenuity is used to find and separate these. There is a chance of an explosion damaging the converter if the pressure vessels are scrapped and then transported to the converter. Before they are charged to the converter, it is crucial to identify and classify the pressure vessels in the scrap. In the scrap preparation facility, there are cameras for each scrap scale to check whether there is a pressure vessel in the scrap during the loading of the scraps with the help of polyps/magnets into the box, and these cameras record the image of the scrap inside the scrap boxes. This study, it is aimed to detect possible pressure vessels by scanning automatically taken images with image processing techniques.



MODERNIZATION AND REPLACEMENT OF İSDEMİR 4TH BLAST FURNACE CLAY GUN AND DRILL EQUIPMENT

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Türkiye

The clay gun and drill machine in İSDEMİR 4th Blast Furnace (4th YF) were modernized and replaced. In Blast Furnaces; iron ore, pellet, sinter, metallurgical coke etc. Liquid iron and blast furnace slag are obtained in the lower zone of the furnace by making the raw material charge from BLT (Bell Less Top System), blowing hot air in the furnace tuyere area and injection of pulverized coal (PCI). Liquid iron and slag are taken into the runner by drilling the mud from the casting hole by hammering and rotating from the casting opening hole using a hydraulic furnace opening drill machine. Liquid iron and slag are separated in the runner. After that, Liquid iron is taken to the torpedo and sent to the steel shop by rail for steel production. After the liquid iron and slag are removed from the furnace floor in the casting opened with a drill, the blast furnace casting hole is closed with a clay gun by pressing approximately 280 bar from the clay gun plugging mechanism. In order to adapt to today's conditions and technology, the clay gun and drill were redesigned, the hydraulic lines were revised, and the projects were designed and modernized by choosing the same as the 1st Blast Furnace clay gun and drill machine. Thus, the efficiency is increased by minimizing the furnace opening and furnace closing time losses caused by the drill machine and clay gun problems.



IMPROVEMENT OF THE SIPHON OPENING PROCESS IN THE ISDEMIR NEW BLAST FURNACE NO.1

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Türkiye

ISDEMIR Blast Furnace No.1 will have a daily production capacity of 7900 tons of liquid raw iron. The furnace will be the largest blast furnace in Turkey with an internal volume of 3072m³ and will have 4 tapholes. In this study, it will be mentioned how the use of siphon drills (jack dam drill) in the blast furnace casthouse has a positive effect on environmental pollution, occupational health and safety, shortening maintenance times and production continuity. At the same time, the design and usage of the siphon drill will be explained. Siphon zone, located at the end of the main runner in the blast furnace, is the zone where the pig iron and slag are separated. After the siphon is the pig iron secondary runner, the hole that allows the siphon region to open to the pig iron secondary runner is called the siphon hole. Siphon opening is an operation performed in blast furnaces during maintenance and emergencies. This process is part of the blast furnace operation. Its frequency is on average once or twice a month, but this number can increase or decrease. The construction methods of this process can cause occupational safety risks, loss of time, extra work force for personnel and environmental pollution due to dust emissions. In addition, failure to perform this process effectively and on time can lead to production losses. In order to avoid the aforementioned risks and important problems, a new equipment called a jack dam drill was provided for the Blast Furnace No.1, which was rebuilt by ISDEMIR and is the largest blast furnace in Turkey. The Blast Furnace No.1 casthouse has been specially designed to be suitable for the installation and use of this equipment. It is planned to contribute to reducing environmental pollution with the use of siphon drills, to contribute to occupational safety by making unmanned work, to prevent production losses by preventing prolongation of shut-down time and to contribute to production continuity.



DISTRIBUTION OF COIL AND WIRE ROD PRODUCTS MANUFACTURED AT ISDEMİR ACCORDING TO AREAS OF USAGE, STANDARDS AND CUSTOMER EXPECTATIONS

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Türkiye

ISDEMİR is an integrated iron and steel facility, which produces both long and flat products from production of iron ore. Wire rod, billet, coil with mill edge, slitted or trimmed coil and cut length plate can be stated Isdemir's product mix. Each of these products have different usage areas and customer expectations. ISDEMİR has a wide range of application areas with the hot rolled flat products or long products, which are expressed as wire rods-billets in order to respond to the customers', who operated in the industrial area and have different demands and expectations, requests. Micro-alloy high-strength steel grades with excellent results in high-strength applications for flat products are used in the production of wheel rim and chassis parts, which requires high strength and superior formability in the basic input of automotive. Boiler steels suitable for use under high temperature and pressure are used in the production of boiler and pressure vessels. Due to high formability, excellent weldability and toughness properties, tube steels are used production of LPG tubes, which are exposed to high temperature and pressure. Medium and high strength shipbuilding steels, which provide superior weldability and desired toughness values, are used in shipbuilding (ship parts, keel etc.). General structural steels, which can be welded by conventional methods and whose mechanical properties are guaranteed and ductility and toughness are optimized, are used in general construction manufacturing. In addition, there are also coil products used in the manufacture of bolts, nuts, springs, fine wire, electrode holders, welding wire and pre-stressed concrete wire. In this study, it is aimed to examine the long and flat products produced in ISDEMİR in terms of usage and customer expectations.



ESTABLISHING A BILLET QUALITY RECOMMENDATION SYSTEM (DIGITALIZATION)

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Türkiye

An average of 30-40 different quality productions take place every month in İsdemir wire rod mill. For some grades, regular orders are entered every month, and for some, there is rarely an order entry. In the billet casting machines in the continuous casting facility, the castings are cast on a tundish basis and are produced in tundish with an average of 5 castings (1000 tons). For grades with rare order entry tightness, 1 tundish casting may result in a stock situation that is not produced for the customer. In İsdemir terminology, this stock is called customer waiting billet stock. For example, the quality 5.2600_05 is a quality entered at rare intervals with low customer potential. On average, orders are made between 300-500 tons in 4-5 month periods. When we buy 1 tundish (1000 tons) casting for this order group, an average of 500-700 tons of excess billet stocks are formed. These billets are in stock for a long time. As a result of the joint work of the Software and Production Planning departments, the billet quality recommendation systematic was created on the UYS (Production Management System). Thanks to this report, it is possible to see the quality of all the billets waiting in the stock, which can be connected in terms of analysis, based on casting. The report can be followed live instantly from the UYS (Production Management System) system. Thanks to the project, it is aimed both to bring the billets that have been waiting in stock for a long time to order, and to quickly deliver the grades with low casting tonnage (cannot be produced tundish) or for which less orders are entered to the customers.



MINIMIZING THE CONSUMPTION OF TEMPERATURE PROBE BY PREDICTION OF LIQUID STEEL TEMPERATURE DURING LADLE FURNACE PROCESS

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In the blast furnace-based steel production plants, liquid iron desulfurization is carried out according to the target value on the basis of the steel quality to be produced at the desulfurization plant. Afterwards, in the basic oxygen furnace (BOF), liquid steel is obtained by blowing oxygen onto the bath consisting of liquid raw iron and steel scrap. The liquid steel produced taken to ladle furnaces for heating, alloying and steel cleaning processes before the continuous casting process. In ladle furnaces, temperature measurements both during and at the end of the treatments are important for the ladle furnace process. In İSDEMİR ladle furnaces, an average of four temperature measurements are taken per heating during the process. It is important to know the temperature value during the process steps in the ladle furnace. Liquid steel temperature is critical for production continuity, production efficiency and quality. In the study, the liquid steel temperature during the process in the ladle furnaces was calculated by means of a model obtained by the multiple linear regression analysis method. The R-sq (adj) value of the model is 92.34% and its power to explain the output is very high. The resulting regression model was integrated into the Level-2 system and made available to the operators. Thus, both the occupational health and safety risks occurred during the liquid steel temperature measurements and the amount of temperature probe consumption per casting are reduced.



COIL MOVEMENT OPTIMIZATION

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İsdemir coil stockyard is the place where the coils were stacked according to a certain systematic after production and then other necessary operations have been carried out in order to ship them to the customer. In addition to this main task, the coils are stacked in such a way to send to different lines. There are many criteria that need to be reviewed for stacking coils with different properties of coils. It is difficult for the operator to review all of them in terms of sustainability. To solve this, an automatic address suggestion algorithm has been created and implemented in the İsdemir coil stockyard. Bringing the coil to the best point where it could be stacked and picking it up from the best point had a positive effect on the entire field operation. Due to the homogenization of the stacks (dimensional and steel quality); improvements have been provided in occupational safety, 5S and process safety. By stacking the coils according to a certain criterion, the number of unaddressed coils in the field has decreased. The time of making the coils ready for shipment and the number of crane manipulations have been improved. Since the control of the field stacking conditions was made automatically, the operators only started to act as operators. Results had recorded and compared with historical data. The number of repeated handling in the field has decreased. Coil stacks have become safer. The delivery process of the coils to the customer has been improved.



IMPROVEMENT OF SCALE PRINT DEFECT IN CUT-TO-LENGTH PLANTS FOR S600 MC STEEL GRADE

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Türkiye

In the production of high-strength S600 MC grade suitable for chassis production in the automotive sector at İsdemir facilities, the scale structure is a sensitive issue that needs to be managed in terms of surface quality. In chassis production, cut to length process from hot coil, mold forming, punching on sheet, and surface cleaning by sandblasting are performed respectively. When the scale formation of hot rolled coil has a thick and fragile formation, scale powdering is formed during uncoiling of the coils and it prints into the steel surface with the pressure of the straightening and leveller rollers, creating a defect. Although the chassis is not a visible part in the vehicle, the formation of submerged scale defects on the surface causes the requirement for additional sandblasting before painting. With an adhesive and thinner scale formation in hot rolled coil, it is possible to prevent scale printed defect in the cut-to-length systems.

In this study, the strengthening mechanism by affected rolling mill parameters and chemistry, scale formation, uncoiling and cut-to-length systems, and defect solving methods will be studied for the steel grade S600 MC. The ratios of Wustite(FeO), Magnetite(Fe_3O_4) and Hematite(Fe_2O_3) phases in scale formation vary according to hot rolling temperatures and run-out table cooling type. Scale thickness is the total thickness of all phases and it is preferred to have low thicknesses (7-8 microns). Wustite based scale formation which is more sticky and less fragile cause less powdering.



SINTER PLANT CIRCULAR COOLER MEDIUM VOLTAGE FAN MOTOR CONVERSION FROM DOL SYSTEM TO VFD SYSTEM

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Türkiye

Sintering of iron ore is the enlargement of powdered iron ores (0-10 mm.), which cannot be used directly in blast furnaces, by undergoing semi-reduction with the help of coke powder. The sinter at the temperature of 700-850 Å°C at the exit of the sinter machine must be cooled to temperatures of 100-120 Å°C in order to provide manipulation to the next process. For the cooling process, atmospheric air is applied to the hot sinter by means of fans. With the awareness of efficient use of resources, the continuity of energy saving and quality-oriented improvement studies in production lines is always one of the priority issues.

In this study; the conversion of the circular cooler cooling fan, which is one of the main components of the sinter plant, medium voltage DOL system to medium voltage VFD system, provided gains such as energy savings, process continuity and technology improvement.



EFFECT OF DUNIT AND DOLOMITE AUXILIARY RAW MATERIALS ON SiO_2 OUTPUT IN PRODUCT SINTER AND COST ADVANTAGE IN THE SINTER PROCESS

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Türkiye

Sintering of iron-containing ore is the agglomeration process of powdered iron ores (0-10 mm.), which can be used in blast furnaces, by reduction with the help of coke powder and/or anthracite. In the sinter process, sinter chemical analysis of the target product can be carried out by using auxiliary raw materials such as dunite, dolomite, olivine, limestone. Dosed dunite or dolomite is used as MgO input, and has an effect on SiO_2 . The continuity of resources in quality and cost oriented improvement studies has always been one of the priority issues.

In this study; After the use of dolomite auxiliary raw material instead of dunite in the sinter process, the SiO_2 value in the sinter chemical analysis of the target product was improved and a cost advantage was achieved. In addition, due to the low CaO input due to the sinter alkalinity in the Blast Furnace process, the volume of the furnace slag decreased.



MAPPING SLAB DEFECTS, CONCEPTUALIZING DIGITAL TWINS

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Process Defects that occur during casting, remain one of the most challenging obstacles in Slab Casting Plant, in terms of Quality and Casting Continuity. Slabs with process defects, in case of later detection and on their defect levels, are mostly re-processed by time-consuming and high-cost treatments, or even being sent to scrap in some cases, which causes much greater financial losses. Non-detected defects cause delay and breakdowns in subsequent plants with much greater and critical financial losses. Therefore, pre-detecting those defects via process parameters, predicting them via artificial intelligent systems, and detecting them with cutting-edge technologies, is one of the main focuses of Continuous Casting Technologies, in recent. Since, it is a known phenomenon that there is an important correlation between process defects and process parameters, observing, virtualizing, simulating them against each other, and eventually developing predictive models based on those studies, can give a better chance to foresee and prevent them before occurring. By Mapping Slab Defects, Digital Twin for Slab Casting process is being conceptualized, in Iskenderun Iron and Steel Co. (ISDEMİR). By this application, slab process defects and crack warnings/ detections, are digitally mapped against instantly stored process parameters, as regards selected Plant, Sequence, Tundish, Heat, or Slab.



ADVANTAGE AT LADLE FURNACE PROCESSING TIME BY DEVELOPING A MODEL THAT CALCULATES LIQUID STEEL %AL VALUE CLOSER TO THE SPECTRAL SAMPLE RESULT

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For the plants producing from ore, the steel production process starts with the charging of scrap metal to the BOF, adding hot metal onto it, and then ending with blowing oxygen at high flow rate for 13-15 minutes by means of an overhead lance. After this stage, the liquid steel in the converter is poured into the steel ladle, which is lined with refractory bricks. As a result of exothermic reactions in BOF, the ratio of elements that can react with oxygen in liquid steel decreases. Due to the nature of the process, some of the oxygen remains free in the liquid steel. In order to provide the chemical content of the casting in the production line, to avoid castability problems, to achieve the hot workability of the product and the targeted mechanical properties, the oxygen in the liquid steel must be removed. To reduce the oxygen solubility, alloy materials containing elements such as Al, Si, Mn, which have higher oxygen affinity than Fe, are used. The deoxidizers used for this purpose are ferromanganese, ferrosilic, ferrosilicomanganese and aluminum. After the oxygen blowing process in the converter is completed, aluminum is used for slab grades for the deoxidation of the dissolved oxygen remaining in the steel and for alloying at the tapping stage. Subsequently, final deoxidation and final alloying with wire Al is carried out in ladle furnaces. After pre-oxidation in the steel tapping step, the final deoxidation and alloying is done in the ladle furnace. It is important for the secondary metallurgy process that the percentage of aluminum in the liquid steel can be seen accurately and in a short time in ladle furnaces. The usage of aluminum above ideal conditions in liquid steel has a negative effect on steel cleanliness due to the increase in inclusions. In cases where there is not enough time to wait for the laboratory analysis result and/or this waiting period is not suitable in terms of steel cleanliness and castability, the need for quality change or the risk of loss of speed in casting machines may occur. In the study, a model estimating the %Al value of liquid steel was obtained with the simple linear regression analysis method and thermodynamic simulation programs. The model was adapted into the Level-2 application and presented to the use of operators. When needed, measurement was taken with an oxygen probe and 5 minutes of gain was achieved in the process time according to the current situation.



WIRE ROD SURFACE EXAMINATION BY NON-DESTRUCTIVE LIQUID PENETRANT TESTING METHOD

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Although many data-based analyzes and models have been made to prevent the formation of defects with process control techniques in steel production processes, it has not been clearly provided to completely eliminate the formation of defects in the products produced. Despite controlled process, there are still defects that may occur due to systems and equipment or raw materials. Therefore, in addition to process control, it is necessary to physically control the manufactured product. Destructive testing methods are generally used at this stage, and particularly wire-shaped samples are cut for examination using hot or cold acid or a microscope. These examinations can cause additional time and wire rod mill process line downtime. In this study, liquid penetrant testing method has been included as an alternative to the eddy current method, which is frequently used in wire-rod production, and experiments have been performed considering that the method can enable the detection of wire rod surface cracks.



THE EFFECT OF DEBINDING PARAMETERS ON ADDITIVE MANUFACTURED 316L STAINLESS STEEL PARTS WITH COLD METAL FUSION TECHNOLOGY

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In Cold Metal Fusion-Technology (CMF), powdered metal is incorporated into a matrix of plastic binder. The feedstock powder is suited for use with an Selective Laser Sintering (SLS) system as well as debinding processes. In the present study, a commercial 316L stainless steel powder mixture with a binder was subjected to SLS, debinding operations.

Powder-binder mixture (feedstock) was procured from a commercial company (Headmade Materials GmbH). Selective laser sintering (SLS) was employed to create the green part samples. Obtained green part samples were treated in acetone, n-heptan and propanol solvents at 30°C, 40°C, 50°C for 4 to 60 hours and their effects on weight loss and density values were examined. Sample densities were measured using a He pycnometer. The optimum debinding parameters were investigated to obtain final parts with higher densities.



EFFECT OF CONTINUOUS COOLING ON MICROSTRUCTURAL AND MECHANICAL PROPERTIES OF A LOW CARBON MICROALLOYED MN-SI BAINITIC STEEL

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Steels with a bainitic microstructure offer great possibilities for highly stressed forged components. Various combinations of mechanical properties can thereby be adjusted in these steels, dependent on the morphology of the bainitic phase. Also, the bainitic structure obtained by continuous cooling offers an advantage since it can eliminate laborious and long heat treatment steps. The aim is to obtain the bainitic microstructure without using complicated heat treatment procedures. In this study, steels with a composition respectively (0.2% C, 1.35%Si, 1.5% Mn) and (0.2% C, 0.3%Si, 1.5% Mn) are investigated. The microstructural studies have been carried out in continuously cooled and isothermally transformed specimens. Optical and scanning electron microscopy were used to observe the microstructural morphology of all those steels. Mechanical properties were investigated by hardness test and retained austenite content was determined by XRD methods. It is shown that as silicon (Si) content increases retained austenite amount in the final microstructure is slightly reduced. High-strength steels (>900 MPa) with adequate ductility were obtained in continuously cooled specimens.



THE EFFECT OF CHEMICAL COMPOSITION AND RATIO OF DEFORMATION ON MECHANICAL PROPERTIES IN HIGH CARBON STEEL WIRE PRODUCTION

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Türkiye

High carbon steel wires are used in many fields, especially in automotive, white goods, agricultural applications and wire ropes. Wire drawing, which is a cold deformation method, can vary in its mechanical properties according to the wire rod used, the total reduction ratio applied, the wire drawing process conditions and the wire drawing dies in process. Mechanical properties such as tensile strength, ductility, reduction in area after fracture and hardness, which are limited in production standards according to the targeted diameter and quality class, determine the performance of the wire in the field of end use. In this study, the effects of % reduction ratio and %C composition on mechanical properties were investigated in the production of 1.00 mm SM (medium tensile strength under static stress) quality steel wire are limited in production standards according to the targeted diameter and quality class, determine the performance of the wire in the field of end use.



EXPERIMENTAL INVESTIGATION OF MECHANICAL PERFORMANCE TESTS OF IMPREGNATED PLASTIC CORE STEEL WIRE ROPE AND IMPREGNATED PLASTIC CORE SWAGED STEEL WIRE ROPE

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Türkiye

Steel wire ropes are lifting equipment of produced in different area according to the place of use. Equipment of steel wire ropes used in many areas such as fishing, oil&gas, marine and mining. Constructions of steel wire ropes effect of mechanical properties including bending fatigue, breaking load, and wear resistance. Impregnated plastic core (EPIWRC) steel wire ropes extensively used in marine areas. Plastic coating between are steel core and another strands increases the corrosion resistance and wire rope fatigue life of the steel core. With the swaging process, the metallic fill factor in the unit cross section area and pulley contact surface increases an the impregnated plastic core steel wire rope. In this study, the differences in wear resistance, bending fatigue, corrosion performance, breaking load between plastic-filled swaged ropes and plastic-filled steel ropes were investigated.



HYBRID WIRE STEEL ROPE WITH COMPOSITE CORE

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Türkiye

Ropes are conveying equipment operating under axial load. According to the field of use in industry, ropes find use in different strength classes and properties. With the increase in competition in the global market, the cost of consumables has come to the fore, and the use of products with minimal harm to the environment has gained importance. At this point, the need for economical, high-strength and environmentally friendly products has emerged in the steel rope industry. Within the scope of this study, steel ropes have been lightened by using a polymer material instead of steel with high strength and low specific gravity, and products with higher strength and minimized environmental damage have been obtained compared to the steel core of the same rope. In addition, different polymers were tested for the polymer material used in the core of the rope, and the most suitable material was selected in terms of production parameters, product performance and cost. Corrosion performance, breaking strength performance and fatigue life performance results were examined as a result of the performance tests performed on the products obtained as a result of prototype productions.



COMPARISON OF BREAKING LOAD AND SERVICE LIFE OF STEEL WIRE ROPES WITH PARALLEL WIRE ROPE CORE (PWRC) AND INDEPENDENT WIRE ROPE CORE (IWRC)

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Steel wire ropes are load-lifting equipment with superior performance used in various industries. One of the most basic parameters of steel wire ropes is the breaking load. Breaking load can be increased by producing ropes with different properties. Steel wire ropes can be produced with fibre core, independent wire rope core and parallel wire rope core. There are 2 closing processes in ropes with IWRC are called steel core and rope closing. The operation in which the steel core and rope closing process is done at the same time is called the parallel closing method. One of the methods to increase the breaking load of rope is the parallel closing method. Steel wire ropes produced with parallel closing method are used as suspension ropes in industry. In this study, the breaking load increase was obtained by increasing the metallic cross section per unit area by producing with the parallel closing method. At the same time, ropes produced with the parallel closing method have a higher service life. In this study, the tests were carried out under laboratory conditions. Performance may vary depending on industrial usage conditions.



REDUCING THE AMOUNT OF SLAG CARRY OFF FROM THE LADLE IN THE CONTINUOUS CASTING PROCESS

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Türkiye

Continuous Casting process are aimed process safety, product quality and high production efficiency as well as production continuity. In this context, the integration of current technologies into the existing system is great importance in slab machines. In the continuous casting process, the molten steel coming from the ladle is transferred to the steel tundish after that transferred from the tundish to the water-cooled mold to produce semi-finished products. Ladle slag is recognized as one of the most important factors ensuring steel quality and process safety in production of liquid steel. In the continuous casting process, a minimum amount of ladle slag is required to carry over the tundish. Currently, operators are responsible for controlling the steel flow from the ladle to the tundish. The slag passing from the ladle to the tundish is detected by the glow on the tundish surface and the ladle is closed. Depending on the experience of the personnel, a large amount of slag may flow from the ladle to the tundish, or useful steel may be scrap as a result of early closing of the ladle. Excess slag flowing into the tundish; It damages tundish walls, increases quality defects and puts process safety at risk. In the current situation, operating costs increase or decrease according to the person-based performance of the systematic that depends on the operator. In addition, this situation causes quality defects and a decrease in production efficiency. Electromagnetic sensor was placed the bottom of the ladle for improvement work. The sensor detects the slag-liquid steel density difference; It prevents the slag carry out from the ladle to the tundish. The sensor detects the slag, closing the ladle slider and eliminating operator initiative. Accordingly, an improvement has been achieved in cost and labor issues.



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PRODUCTION OF FUNCTIONALLY GRADED MATERIALS BASED ON FLG REINFORCED Al-4.5Cu-1.5Mg BY POWDER METALLURGY

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Functionally graded materials (FGMs) are innovative materials whose properties varies on their position in line with functional requirements as composition, microstructure and so on throughout the volume. Where conventional composites are insufficient for engineering requirements, the availability of potential application areas of FGMs has gradually increased in aerospace, automobile, biomedical, defense, electrical/electronic, energy industries.

Achieving specific morphology and structural competence as physical and mechanical grading is the major advantage of FGMs. 2xxx series Aluminum (Al) alloys, in which is the main alloying element Cu, are generally used in many fields because of physical and mechanical properties such as light weight, high specific strength and high specific modulus. Graphene, one of the allotropes of carbon, is preferred as an ideal reinforcement due to its superior mechanical, electrical and thermal properties. In the present study, few-layered graphene (FLG) with high purity was synthesized by electric arc discharge (EAD) method. The FLG was reinforced to the Al-4.5Cu-1.5Mg alloy matrix powders using various weight fraction of 0%, 0.1%; 0.2%; 0.3%; 0.5% and 0.7 wt.% by mechanical alloying. According to the particle size, X-Ray Diffraction (XRD) and scanning electron microscope (SEM) analyzes, it was observed that the FLG was homogeneously distributed in the Al-4.5Cu-1.5Mg alloy based matrix.

These FLG reinforced composite powders were stacked as six layers and consolidated due to their FLG content considering the FGM design and it was sintered at 590°C for 3 hours under Argon atmosphere. The mechanical and structural properties of FLG reinforced Al-4.5Cu-1.5Mg alloy-based FGM which was successfully produced, were investigated.

It was seen that the FLG was graded homogeneously in the alloy matrix due to their content and FLG was placed between the grains acts as a barrier due to gradation of FLG content was observed at the optical and SEM images. According to the design of FGM, an increase in the micro hardness by 48% was observed from the bottom layer where the FLG content was low to the top layer.



EFFECT OF ANODIZING THICKNESS ON CORROSION BEHAVIOUR OF 2011 ALUMINIUM ALLOY

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Elements with low melting points like Bi, Pb, Sn may increase machinability of alloys by precipitating directly at grain boundary with the compound they form. In this way, it is highly preferred in alloy composition where machinability is important. Natural gas valves are the product group in which materials with good machinability are preferred. Valves must have high corrosion resistance due to their intended use. Within this framework, effect of anodizing thickness on corrosion behaviour of 2011 aluminium alloy were investigated in this study. In experimental studies, EN AW 2011 aluminium alloy in T6 heat treatment condition were used as samples. Billets were cast in a prototype direct chill (DC) casting facility and optical emission spectrometry was used to determine the composition of the alloy. Then, homogenization process was carried out. As the next step, billets were extruded with the proper extrusion parameters determined by experimental studies. Produced profiles were cut into small pieces and brought to T6 heat treatment condition by solution heat treatment, quenching and artificial aging processes, respectively. The samples were then anodized at different thicknesses. Anodized and mill finish samples were kept in a corrosive environment. Optical microscope, SEM/EDS were used for characterization.



INVESTIGATION AND FE ANALYSIS OF EARING AMOUNT AND DIRECTION OF DEEP DRAWING PROCESS OF AN ALUMINIUM SHEET UNDER VARIOUS CONDITION

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Earing problem is the most known problem in the cup drawing process for sheet metals due to the anisotropic nature of blank materials. In this study, earing problem was investigated in deep drawing of cylindrical cups and punch from aluminium sheets both experimentally and numerically. For experimental studies, EN AW 1050-H0 aluminium sheet was determined as forming test material. Experimental sample sheets were produced by TRC (Twin Roll Casting) method. Two stage rolling process was applied to material during manufacturing process. At the last stage of manufacturing process final heat treatment process carried out. In order to observe mechanical properties and formability behavior of test specimen, tensile tests were performed taking cognizance of rolling direction. Several deep drawing tests were conducted to investigate earing amount and direction of the material with different sheet metal thickness and treatment process. Then, finite element studies were carried out with a finite element software. Hill anisotropic yield criterion was used during the FE studies. Experimental and numerical solutions were compared to examine the performance of material properties and yield criterion.



REDUCING ENERGY CONSUMPTION DURING HEAT TREATMENT OF CAST ALUMINUM ALLOYS - OPTIMIZATION OF PROCESS PARAMETERS THROUGH CALPHAD

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In this study, the effect of solution heat treatment temperature and time on the artificial aging response of an EN233 aluminum alloy is investigated. CALculation of PHase Diagrams analysis using Pandat from CompuTherm LLC is performed to evaluate the phase equilibria for different solution treatment conditions. Samples extracted from cylinder head castings provided by an industry partner are subjected to different solution heat treatment conditions that are selected by CALPHAD analysis. The effect of solution treatment conditions on artificial aging response and energy consumption are evaluated.



INVESTIGATION OF MICROSTRUCTURE OF HOMOGENIZED ALUMINUM ALLOYS IN THE BATCH HOMOGENIZATION PLANT AND CONTINUOUS HOMOGENIZATION PLANT

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Vertical direct chill casting (VDC) is an advanced method for producing wrought aluminium alloys in billets and slabs. However, as-casted aluminium alloys have low formability due to some microstructure inhomogeneities such as micro-segregation, grain boundary segregation, low melting point eutectics and brittle intermetallic compounds. That's why, homogenization process has to be performed cast billets to partly or completely eliminate in the structure. After homogenization process, cast billets can be easily formable by extrusion process. Commercially, there are two different types of homogenization plants in the modern cast house: batch-type homogenization and continuous homogenization plant. For 6xxx series aluminium alloys, continuous homogenization process is most preferable by most of customers because of lowest labour costs, lowest energy consumption and straightness of billets. On the other hand, the batch-type homogenization process is favoured for the large billet diameter and some special aluminium alloys having long holding times. The principle aim of this study is to investigate the comparison of microstructures of homogenized billets in the batch and continuous homogenization process. These two plants were installed as well by Sistem Teknik Industrial Furnace LTD. The results were used in the development of two facilities in terms of microstructure and energy consumption.



PARAMETRIC APPROACH OF A NOVEL HEAT TREATMENT ON Al-Mg-Si ALLOYS: RETROGRESSION AND RE-AGING

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The method of rapidly heat-treating locally or along their length at various tempers using induction heating methods to return or approach their highly ductile state is termed retrogression. The process, which is a sequential combination of retrogression and re-aging heat treatments, which provides an increase in corrosion resistance with a relative loss of mechanical properties, is called RRA. With their good weldability, good strength/weight ratio, and excellent formability, 6XXX series aluminum alloys appeal to many sectors but are mostly used in building sector applications. The improvement provided by the RRA process in corrosion resistance and the effective gains that this improvement will provide in the construction sector, where 6XXX series alloys are frequently used, have been the objectives for the results of the experimental process in the study. In this context, an experimental setup was prepared in which EN AW 6063 (Al - (0.75-0.8%) Mg2Si) alloys were used as samples in order to investigate the effect of aging parameters for the RRA application. Various times and temperatures were chosen for re-aging under constant retrogression parameters. The microstructural investigation, mechanical testing, and conductivity measurements have been done to gain knowledge and build links about precipitation characteristics of extruded Al-Mg-Si alloy over mechanical and electrical properties by changing microstructure.



INFLUENCE OF Mg CONTENT ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF EN AW 6082 ALLOYS

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EN AW 6082 is one of the most popular high strength Al-Mg-Si alloys for structural profiles. In the present study, it is aimed to investigate the influence of Mg addition on the mechanical properties of EN AW 6082. Commercial 6082 alloy and pure Mg (99.9%) ingot were used for alloying and laboratory scale casting experiments. The final composition was measured by arc spark optical emission spectroscopy. As-cast samples were solution heat treated at 560°C for 3 hours in order to dissolve soluble elements from the alloy into solid solution followed by water quenching. The solution heat treated/water quenched samples were aged at 185°C for 1, 2, 4, 6, 8 and 10 hours followed by air cooling in order to improve mechanical properties. Brinell hardness measurements of as-cast, solution heat treated and aged samples were performed on the polished cross sections and measurements were taken from 5 different points. The hardness increased from 110 to 120 HBW due to the addition of Mg, at the optimum aging conditions (185°C, 6 hours) for Mg-added 6082 alloys. The morphologies of the intermetallic of the alloys were analyzed by scanning electron microscopy (SEM). The results indicated that hardness of the alloy increase with increasing Mg content and with low cycle aging time.



GOLD EXTRACTION FROM OXIDE GOLD ORES BY GLYCINE LEACHING

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Gold is a yellow-coloured metal with the greatest ductility and malleability. Except for selenic acid, simple acids do not dissolve gold. However, in the presence of oxidants such as nitric acid, oxygen, manganese dioxide, hydrochloric acid dissolves gold. The basic system used to extract gold from its ores is the process in which gold is dissolved in cyanide and oxygen is used as the oxidant. In this study, leaching experiments were carried out using glycine, a non-toxic reagent.



AN UPDATE FOR CRITICAL RAW MATERIALS (CRMS)

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Raw materials form the industrial basis of various products and applications used in modern technologies and in daily life. Minerals, mineral concentrates, compounds and metallic semi-products are among these raw materials which have to be used to sustain all activities by human beings. Although economic importance and supply risk have been well-known features since the time humankind passed from being hunter-gatherer to being agriculture-assisted, calculation of those aspects have been a relatively new concept (over the last two decades) to point out sustainable development of the nations which utilize raw materials for industrial production. This concept is called “Critical Raw Materials” (CRMs). The first CRMs list was released by the European Commission in 2011 containing 14 raw materials and, the number of raw materials was increased up to 30 in 2020 by the EU. In the present study, historical background, development of the EU’s CRM list and the calculation of CRM list in the EU perspective are given in detail with the properties of the raw materials in the list. Moreover, 2020 updated CRMs list is introduced in detail.



ENVIRONMENTAL IMPACT OF HYDROMETALLURGICAL ZINC PRODUCTION

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The present study aims to examine and assess the environmental impact of a typical hydrometallurgical zinc production technology. As an example, a real operating installation in KCM - SA, Plovdiv, Bulgaria is considered. KCM is the largest producer of zinc and lead for South- Eastern Europe. The exergy method of thermodynamic analysis was used as a research method. A precise exergy assessment of the basic chemical-technological units as well as of the overall system has been obtained.



INDUSTRIAL SCALE EXTRACTION OF LITHIUM CARBONATE AND RARE EARTH ELEMENTS FROM DOMESTIC SOURCES

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Extraction of lithium carbonate and rare earth production from domestic resources was explained in this study. Lithium carbonate extraction was carried out by using brines obtained from Tuz Lake, while rare earths was synthesised from Beylikova. Optimal conditions of hydrometallurgical extraction of lithium carbonate were determined. Crushing, screening, grinding, dimensional classification, leaching, solvent extraction (SX), impurity removal, and precipitation stages of rare earth extraction was stated.



TRANSFORMATION IN MINING AND GREEN METALS

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We are witnessing a fundamental shift in mining. Non availability of rich deposits of mine, logistic obstacles, and difficulty of exploring mines from politically instable countries are three of the problems. Automation and robotics in mining, shortly working smarter, are very attractive and highly beneficial. Deep sea mining is one of most innovative area in this field.

Green technologies have one thing in common: more intensive use of metals in products and systems. Usage of metals in carbonless economy should increase substantially by 2050 to meet climate policy. Top seven metals for green technologies are aluminium, copper, cobalt, silver, lithium, zinc, and nickel. Demand for some metals, like lithium, could increase 500% in decades. An inadequate response from production, heavy price volatility, or lower needs than anticipated could result in a misaligned supply and demand, upward or downward price changing in metals and commodities.



EFFECT OF HEAT TREATMENT ON MICROSTRUCTURE AND CORROSION BEHAVIORS OF ADDITIVE MANUFACTURED Ti-6Al-4V USING SLM TYPE 3D PRINTER

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In this study, the effect of the production parameters was investigated on the Ti-6Al-4V (Ti64) samples produced using a Selective Laser Melting (SLM) 3D printer. Microstructure, corrosion resistance and hardness values of Ti64 samples produced by SLM technique respectively. Optical microscope images were taken for microstructure characterization, and micro-Vickers hardness measurement was performed for the determination of mechanical properties. A 3-electrode technique was used for corrosion resistance measurement. The corrosion test was carried out with anodic potentiodynamic polarization (PDS) and electrochemical impedance spectroscopy (EIS) tests in 3.5% NaCl solution at room temperature and XRD analysis. As a result of the investigations, the effects of energy volume, which is the output of production parameters, and the effects of corrosion resistance were analyzed.



EFFECT OF HF ADDITION ON THE STRUCTURAL PROPERTIES, MICROHARDNESS AND OXIDATION BEHAVIOUR OF Co-Al-W SUPERALLOYS

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The effect of 2 at. % Hf addition and time and temperature of aging treatment on the microstructural and mechanical properties of Co-9Al-6W (at. %) superalloy was investigated. The study has two main aims: (i) the alteration of the microstructural features such as amount, size, distribution and morphology of the constituent phases w.r.t Hf content and aging treatment; (ii) the effect of microstructural alterations on microhardness and oxidation behavior.



HOMOGENIZATION OF THE CuNi12Zn24 ALLOY PRODUCED BY HORIZONTAL CONTINUOUS CASTING

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This research has been focused on the properties of CuNi12Zn24 alloy after homogenization treatment that has been produced in horizontal continuous casting. The existence of impurities such as oxygen, and sulfur based in liquid metal induces surface and internal tensions, as also hot tearing and cracks formed during casting, and hot and cold rolling. The alloy has been produced with a thickness of 18mm, a width of 660 mm, and a length of 50 meters. The milling process has been applied in order to increase the surface quality, following the casting process. Then in order to eliminate the discontinuities and impurities, homogenization annealing has been performed at different temperatures and duration. The microstructure of the homogenized samples has been investigated with optical microscopy and image analysis, and also porosity level of the samples has been determined. Moreover, mechanical properties of the samples have been investigated by the hardness tests.



THERMODYNAMIC AND EXPERIMENTAL APPROACH OF THE PHASE FORMATIONS IN Ti-Nb-Ta-Zr-Mo HIGH ENTROPY ALLOYS

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Thermodynamical approaches, including enthalpy of mixing (ΔH_{mix}) and Thermo-Calc software, were used to estimate the formation of matrix and secondary phases in Ti-Nb-Ta-Zr-Mo high entropy alloys (HEAs). The overall phase formation of the HEAs was estimated by the thermo-physical calculations and compared with the Thermo-Calc results. Both techniques showed similar outputs in terms of phase predictions for the matrix phase. However, the overall thermo-physical calculations failed to estimate minor secondary phases' formation. Binary mixing enthalpies of the substances were used to predict the secondary phases. The experimental studies were conducted on the Ti-Nb-Ta-Zr-Mo HEAs to confirm the secondary phases in the matrix. The HEAs were produced using a vacuum arc melter and analyzed by the X-ray diffraction (XRD) technique. XRD analyses showed dual body-centered cubic (BCC) phases in the microstructure of the HEAs. The increasing Mo content in the HEAs also increased the amount of secondary BCC phase. The results well agreed with the results obtained from Thermo-Calc software. The hardness tests were conducted to reveal the effect of the secondary BCC phase on the mechanical properties of the HEAs. The results showed that the hardness of the HEAs enhanced from 368 to 524 HV with the increasing secondary BCC ratio.



INTEGRATED PROCESSING OF $\text{Al}_x\text{CoCrFeNi-Cu}_a$ ($0.5 \leq x \leq 3$, $A=0.5,1$) HIGH-ENTROPY ALLOYS: FROM MASTER ALLOY SYNTHESIS TO SHAPING

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In this study, an integrated manufacturing process for the lab scale production of semi-finished bars and sheets of $\text{Al}_x\text{CoCrFeNi-Cu}_a$ ($0.5 < x < 3$), ($a=0.5,1$) high-entropy alloys was investigated. The manufacturing steps start at cost and time-efficient pyrometallurgical combustion synthesis of master alloys from oxides through a self-sustained aluminothermic reduction reaction. Post-synthesis metallurgical processes include refining the selected master alloys by remelting, suction-casting via vacuum arc melting, and hot (1000 °C) and cold (25 °C) rolling. Thermochemical modelling via FactSage™ has been applied intensively both during synthesis and post-synthesis steps for precisely tuning the composition of the master alloys and the discussion of the thermodynamic aspects of the phase diagrams for non-equilibrium and final equilibrium conditions. The compositions, phase constituents and microstructure of the alloys were characterized through XRF, XRD, SEM-EDX, and TEM analyses. Mechanical properties were obtained through microvickers and nanoindentation tests.



THERMODYNAMIC AND EXPERIMENTAL INVESTIGATION OF AlCoCrFeNiTi BASED HIGH-ENTROPY ALLOYS

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The aim of this study is to investigate the thermodynamic properties of AlCoCrFeNiTiX based high-entropy alloys (HEA) by using ThermoCalc software and to compare it with the experimental results. The stoichiometric amount of Ti was varied and its effects on the microstructure evaluations and phase transformations in HEA were investigated. The thermodynamic investigations were performed to predict the phases. HEA were characterized by various techniques.



THE OUTLOOK OF NICKEL INDUSTRY AND THE ROLE OF NICKEL AMID THE GREEN REVOLUTION

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Nickel is one of the main non-ferrous metals, and the rate of its use has risen rapidly in recent decades. Nickel is a naturally-occurring metallic element with a silvery-white, shiny appearance. It is the fifth-most common element on earth and occurs extensively in the earth's crust and core. Nickel has outstanding physical and chemical properties, which make it essential in hundreds of thousands of products. Its biggest use is in alloying - particularly with chromium and other metals to produce stainless and heat-resisting steels. Nickel occurs naturally, principally as oxides, sulphides and silicates. Primary nickel is produced and used as ferro-nickel, nickel oxides and other chemicals, and as more or less pure nickel metal. Over two million tonnes of new or primary nickel are produced and used annually in the world. Stainless Steel is the predominant first use for nickel, accounting for 72% of global usage in all forms. It is followed by Ni-Base & Cu-Base Alloys (7%), Alloy Steels (7%) and Batteries at 7%. It could be argued that the cone of uncertainty in nickel five years from now remains extremely wide. Flexing electric vehicle penetration, battery size or cathode chemistry expectations can give a wide range of outcomes for demand, while the scale of potential supply growth in Indonesia is a subject of much debate. Whatever way you look at it, however, based on a strong foundation of stainless steel with strong battery upside, demand growth looks extremely robust. However, this is more a function of the type of supply available rather than demand needs. Stainless steel mills much prefer purchasing ferronickel than nickel cathodes, which are more expensive to buy and to melt. And with stainless steel still making up roughly two-thirds of primary nickel demand, and a combination of ferronickel and NPI only making up ~58% of nickel supply. Moreover, relative to NPI, ferronickel production does involve less energy use, and thus carbon footprint. Nickel is critical in delivering resilient clean energy such as solar, wind, geothermal and hydrogen hence Nickel still has new stories to tell.



THE EFFECT OF COOLANTS ON THE SURFACE QUALITY OF ALUMINIUM PRESSURE DIE-CASTING ALLOYS IN MACHNING PROCESS

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In the aluminium casting industry, high pressure die-casting is indispensable due to higher production rate, reduced section thickness, improved mechanical properties, and so on. In this study, the effects of two coolants, namely environmentally friendly boron and biocide-free (dualCys™) were investigated within machining process fabricated via high pressure die-casting process which is widespread alloy for several components in the automotive industry. The specimens were characterized via scanning electron microscope and energy dispersive spectrum.



THE EFFECT OF JET-COOLING APPLICATION ON MICROSTRUCTURAL PROPERTIES OF THE OVERHEATING AREAS IN HIGH PRESSURE DIE CASTING PARTS

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In this study, the aluminum part demands of the industry are met in the high pressure die casting process. Some problems are encountered in the production of complex shaped parts in the high-pressure casting process. The effect of jet cooling application was investigated to find solutions to the problems encountered because of overheating of the mold due to the figure shape. High temperature zones of the mold cause defect such as porosity and shrinkage on the part. In addition, the temperature difference that the mold steel is exposed to affects the steel life negatively. For this reason, parts were produced by applying jet cooling, which is a kind of fast cooling system. The produced samples were characterized by optical microscope, X-ray and thermal images of the mold during the production phase.



THE EFFECT OF NITROGEN GAS PURGING ON THE MECHANICAL PROPERTIES OF VERTICAL SEMI-CONTINUOUS CASTING

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The casting has been done in a vertical semi-continuous casting (slab) furnace. It has high mechanical properties, acid and corrosion resistance, due to excessive use of raw material and exposed to the air to molten material porosity occurred and this is one of the main problems that has been faced for this alloy during casting. These porosities cause shells and laminations that affect the material adversely on the surface of the final product. In order to eliminate the porosity problem, inert gas (nitrogen) has been carried out to the furnace during melting.



THE EFFECT OF PROCESS PARAMETERS ON THE EDGE QUALITY IN ALUMINUM COIL SLITTING OPERATION

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The aluminum coils produced by the continuous casting method are processed by cold rolling and different processes and are cutting in the dimensions requested by the customer. Cutting operation in flat aluminum products is carried out with 2 main operations as cut to length and coil slitting. Slitting edge quality has a critical importance in usage areas such as automotive, electricity and energy, welding applications, roll painting etc.. It is important that the edge quality is high, as it causes different types of defects in the specified sectors.

In this study, the process parameters (gap of blades, penetration, material tension, flatness, blade and material lubricity, material entry angle etc.) affecting edge quality in different material properties in coil slitting processes in 1050 H0 / H24 / H19 and 3105 alloy H24, H19 conditions. , rubber hardness, rubber diameters, burr direction, intermediate annealing and finally annealing process types, speed difference between blade and winder mandrel) were investigated. Experiments were made in different process parameters and the formed edge cutting surfaces were examined by surface analysis techniques such as Stereo Microscope, SEM. As a result of these studies, the process parameters required for optimum edge quality were determined. In addition, details about verified applications are specified.



NICKEL RECOVERY FROM OLIVINE BY HYDROMETALLURGICAL METHOD

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In this study, the Ni recovery and the change in the Fe ratio in its content were investigated by using olivine separated from the magnetic separator in Elazığ, Eti Krom INC. The effects of acid leaching, time, roasting and mechanical activation on Ni recovery were investigated. In Eti Krom INC. it is aimed to add value to the waste material by recovering metal from olivine, which is in waste state.

In order to examine the effect of temperature on %Ni recovery, 3 different temperatures (45 OC, 65 OC, 85 OC) were carried out with using 2 different acids. In order to examine the effect of mixing time, 6 different time (15 min, 60 min, 120 min, 180 min, 360 min, 480 min) were tried. The effects of roasting and mechanical activation on leaching were also investigated. During the study we also followed the % Fe solubility which has the highest solubility in olivine, has the most impurity, dissolves easily and passes into the solution easily with Ni, which is the target metal.

As a result of this study, the % Ni recovery is 32.8%. The % Fe solubility is 40.181%. In all studies, the recovery did not exceed 32%, but the % Fe solubility was extreme high. Secondly, the highest yield % Ni recovery is 26.82% and % Fe solubility are 12.90%.



INVESTIGATION OF ROASTING BEHAVIOR AND MINERALOGICAL TRANSFORMATION OF TITANOMAGNETITE CONCENTRATE AT DIFFERENT TEMPERATURES

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The demand for titanium metal and its compounds is constantly increasing. Titanium's versatility, technological advancements, and increasing human population drive nations to demand more. This thirst for metals and exploiting mineral resources forces civilizations to harvest low-grade deposits. Titanium is no exception, thanks to its versatility and wide range of applications. There are two commercial titanium minerals, rutile and ilmenite, widely used in industrial applications. However, the decrease of this high-grade ore also causes the evaluation of low-grade ore as a resource. Therefore, titano-magnetite concentrate (TMC), with 4-8 Ti%, 50-54 Fe%, and 0.38-0.58% V content, is a high potential reserve in terms of Ti and V and, obtained by the magnetic enrichment method, has been an alternative source to high-grade ore. However, due to the high iron content of TMC, producing titanium metal and its compounds from these resources is difficult and costly. Thus, removal of the iron minerals, which is one of the major constituents and impurities, is necessary. Since for further metallurgical processes, concentrated and/or enriched materials are needed, titanium enrichment is important. While there are several methods to remove iron minerals, magnetic separation is one of the most effective methods. Despite its easiness and effectiveness, it has a crucial constraint, namely magnetic susceptibility. While some iron minerals such as magnetite and wustite are ferromagnetic and easy to separate with magnetic separators, others like hematite have low magnetic susceptibility. Therefore, they are not suitable for magnetic separation. Fortunately, this drawback can be overcome with a particular solution: magnetization roasting. Through the roasting process, it is possible to convert hematite into magnetite and wustite. In this study, TMC was primarily roasted at 9 different temperatures (from 200 to 1000 °C with 100 °C increments). After roasting, the effects of temperature on the mineralogical transformation were investigated by X-ray diffraction to obtain ideal/optimum experimental parameters. X-ray diffraction patterns show that magnetization takes place between 200-600 °C and peaks at 600 °C. Until this temperature, hematite-magnetite conversion is evident. At this point, the magnetite/hematite ratio reaches 2.75. However, after this point, conversion goes reverse, and hematite occurrence takes place instead of the magnetite formation. At 1000 °C, the magnetite/hematite ratio drops to 0.45. Therefore, according to the findings of this study, 600 °C is optimal for magnetization and following the magnetic separation process.



THE EFFECT OF THE SCALE FACTOR ON ALCOCRFENI BASED HIGH-ENTROPY ALLOYS PRODUCED VIA A SELF-PROPAGATING HIGH-TEMPERATURE SYNTHESIS METHOD

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In this study, high-entropy alloys (HEA) having AlCoCrFeNi stoichiometry were produced via a self-propagating high-temperature synthesis (SHS) method starting from their metal oxide powder mixtures. The effects of the initial weights of raw materials (100-200-300-500-1000 g) on metal recovery values, chemical composition and properties of the final alloys were investigated.



THERMODYNAMIC AND MICROSTRUCTURAL INVESTIGATIONS OF AlCoCrFeNi(Ti)X BASED HIGH-ENTROPY ALLOYS

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In this study, it is aimed to produce AlCoCrFeNi(Ti)x (x=1, 1.2, 1.4, 1.6, 1.8, 2) HEA by vacuum arc melting (VAM) method using high purity metal powder mixtures. The aim of this study is to obtain eutectic structure and to reveal the effects on mechanical properties in case the alloys produced have different eutectic phase ratios.



DEVELOPMENT OF OXIDE DISPERSION STRENGTHENED INCONEL 718 ALLOY BY CALPHAD METHOD AND PRODUCTION OF DESIGNED NOVEL ODS ALLOY BY LASER POWDER BED FUSION

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IN718-YF (IN718 – Y2O3 – FeO) and IN718-YFH (IN718 – Y2O3 – FeO – Hf) alloy compositions were determined by CALPHAD approach. Designed ODS alloys were produced by selective laser melting (SLM) method. FeO and Hf additions have resulted in an increase of number densities of Y-Ti-O & Y-Hf-O nano-oxides and a decrease in nano-oxide particle size distributions. In-situ tensile tests were conducted to obtain high-temperature mechanical behaviors of alloys. Experimental results showed that an increase in nano-oxide number density and a decrease in nano-oxide size distribution improved the tensile strength of the IN718-ODS alloy.



EFFECT OF FeO ADDITION ON Y-Ti-O NANO-OXIDE FORMATION AND SIZE IN INCONEL 718 – ODS ALLOY PRODUCED BY SELECTIVE LASER MELTING METHOD

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FeO and Y₂O₃ were added to IN718 alloy to promote Y-Ti-O nano-oxide formation and to increase number density of nano-oxides. A novel heat treatment was applied to as-built samples in order to anneal oxides. Experimental results showed that average particle size is decreased while number density of oxides reached 200 times of its value compared to as-built state.



COMPARISON OF MICROSTRUCTURE AND MECHANICAL PROPERTIES OF CoCrFeNiMn HIGH-ENTROPY ALLOYS BY UNIAXIALLY PRESSING-SINTERING AND VACUUM HOT PRESSING-SINTERING METHODS

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Powders of a CoCrFeNiMn high entropy alloy were generated in a planetary ball mill and powder characteristics were analyzed using XRD and SEM. Separate processes, uniaxial pressing-pressureless sintering (UNPS) and vacuum hot pressing sintering (VHPS), were utilized to obtain high-entropy CoCrFeNiMn bulk samples. VHPS was at 850 °C for 2 h and UNPS was 1.2 GPa followed pressureless sintering at 1200 °C for 2 h. The results indicated that nano-crystalline FeCoCrNiMn alloys contain FCC phase. Following the sintering procedure, the phases varied depending on the sintering method. The bulk FeCoCrNiMn HEAs consolidated by VHPS exhibited a particularly favorable combination of hardness and wear characteristics.



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INVESTIGATION OF THE INFLUENCE OF AGE HARDENING ON THE CORROSION RESISTANCE AND HARDNESS OF A NANOCRYSTALLINE AA2024 ALLOY

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The objective of this work is to investigate the influence of age hardening on the corrosion and hardness of a nanocrystalline AA2024 alloy. Nanocrystalline AA2024 specimens were prepared by high-energy ball milling of gas atomized AA2024 powder and subsequent compaction under 3GPa of uniaxial pressure at room temperature. Influence of age hardening conditions on the corrosion behavior of AA2024 was analyzed along with the mechanisms that provide superior hardness.



CAN HIGH-STRENGTH STEEL BECOME STAINLESS ALSO WITH LOW CHROMIUM CONTENT?

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High-strength steels are used in demanding applications where a high strength-to-weight ratio is a primary concern. This steel group offers tensile strengths higher than 1000 MPa but is susceptible to environmentally-induced degradation, such as corrosion or hydrogen embrittlement. Hybrid steel is a new-generation low-alloyed high-strength steel that offers exceptionally high corrosion resistance. We performed electrochemical potentiodynamic polarization measurements in 0.1 M and 0.01 M near-neutral sodium chloride solution at room temperature and found that 5Cr-5Ni-2Al Hybrid steel shows similar corrosion behavior to 14% chromium-containing martensitic stainless steel (grade 420). In addition, Hybrid steel was seen to undergo pitting corrosion and indicated spontaneous passivity similar to stainless steel. The exceptional corrosion resistance stems from the mixed oxide of Al, Cr, Ni and Mo species. Our work has shown that steel can also be made stainless without needing a minimum chromium content of 10.5 per cent.



TRIBOCORROSION PROPERTIES OF ELECTROLESS NICKEL-BORON COATINGS FROM STABILIZER-FREE BATH

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Electroless nickel-boron coatings were produced in a stabilizer-free bath. Its properties were investigated in a tribocorrosion test. It is found that its potential slightly increased after sliding. A lower and stable friction coefficient (COF) was observed during the tribocorrosion test when it was compared to the dry sliding test.



TRIBOCORROSION DEGRADATION OF OSTEOINTEGRATED BIOMEDICAL IMPLANTS: MECHANISMS, BIOLOGICAL IMPLICATIONS AND (POSSIBLE) SOLUTIONS

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Metallic-based materials are widely used in dental and orthopaedic implants. Among other factors, lifetime of osseointegrated implants is influenced by the capability of the surface of the implant to induce osteoblasts (bone-forming cells) to adhere, proliferate and mineralize as fast as possible in order to anchor the implant in place. Also, infection, due to the colonization of the surface of the implant material by microorganisms should be avoided. Finally, degradation of the implant surface by tribocorrosion mechanisms (corrosion + mechanical wear) results in the modification of the surface characteristics of the material, but, at the same time, generates micro or nano-sized debris and/or metallic ions that may have a deleterious effect on the biological functions locally and systemically.

This talk will review the tribocorrosion phenomena occurring in osseointegrated implants, with a particular focus on titanium and titanium-based alloys. Strategies followed in the last years to functionalize the surface of the implants through the growth of oxide films with graded properties for optimized biological and tribocorrosion performance will be reviewed. Examples will be given on the influence of the chemical and structural characteristics of the film on the tribocorrosion mechanisms and biological interactions. Finally, the toxicity of degradation products will be highlighted.



EFFECT OF B AND Sr ADDITION TO TRIVALENT CHROMIUM PROCESS (TCP) COATED Al-Si CAST ALLOYS ON CORROSION RESISTANCE

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The corrosion resistance of cast aluminum alloys (EN AC 4xxxx series) is a vital characteristic asked by customers, especially in automotive industry. The alloying elements of aluminum casting alloys directly affect their corrosion resistance. The corrosion resistance of copper-containing aluminum alloys is poor due to micro-galvanic corrosion caused by copper in the alloy. In this study, the effects of EN AC 46000 (Cu ~ 2.5 wt.%) and EN AC 43400 (Cu ~ 0.1% wt.) alloys on the corrosion resistance of both before and after the Trivalent Chromium Process (TCP) with the addition of Sr and B were investigated. Electrochemical Impedance Spectroscopy (EIS) analyzes was applied to compare their corrosion resistance.



STABILITY OF MXENE UNDER EXTREME ENVIRONMENTS

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Corrosion in other words degradation of the material's property is a crucial threat for all technical applications. In this context, graphene family, CNT and carbon nanospheres have been used in various coatings to improve mechanical, chemical, and barrier properties of polymer matrix due to their significant features, including large specific surface area and decent interactions with polymer matrix. MXene, a newfamily of 2D materials, has attracted significant interest due their exceptional features, such as high conductivity and excellent optical, thermal, and mechanical properties. Most importantly, MXenes can act as a diffusion barrier for corrosive ions into the harsh environment. MXenes hold great potential for application in the field of corrosion protective nanocomposite coatings. However, our current understanding on the stability of MXenes and how to improve it in extreme conditions remain controversial. In this work, we will present the oxidation behavior of MXene sheets in air, liquid (water, acetone, and acetonitrile), and solid (ice and polymer) media to understand how storage and/or dispersion media influence MXene oxidation processes.



THE EFFECT OF BORON ADDITION ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF HX TOOL STEEL

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This work handles enhancing hardness and microstructural properties of HX tool steel owing to doping FeB. FeB was doped as boron source. Samples were prepared by using conventional powder metallurgy techniques. Samples were sintered on different conditions. While one group did not include boron, the other one had % 1.5 wt FeB. Two different sintering temperature and time were used to figure out the objective effect of boron doping. Sintered density results, hardness scores and microscope images were provided. Analyses were related to each other. The sample on best condition was detected owing to analyses. Characterization methods were executed to this sample. Analyse and characterization info revealed that was a remarkable increase on sintered density and hardness. The factors that led to this improvement were discussed.



CORROSION BEHAVIOUR OF FEW-LAYERED-GRAPHENE (FLG) REINFORCED AL-4 Wt.%Cu METAL MATRIX COMPOSITES PROCESSED BY MECHANICAL ALLOYING

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Few-Layered-Graphenes (FLGs) were produced via the arc discharge method in our laboratory. The FLGs were incorporated into the matrix at weight fractions of 0, 0.25, and 0.5 and mechanically alloyed (MA'ed) for 5, 7, and 9 hours in a planetary ball mill. The MA'ed powders were consolidated by uniaxially pressing at 300 MPa and pressureless sintering at 590 °C for 3 h. The bulk composites have been evaluated in 3.5% NaCl solution for corrosion properties using potentiodynamic polarization curves. Before conducting electrochemical corrosion testing, samples were submerged for 75 minutes in the test solution to achieve a stable open circuit potential (OCP). The electrochemical polarization curves were obtained by scanning from 400 mV to +400 mV from OCP at a rate of 1 mV s⁻¹. In all cases, pitting corrosion was observed with or without the addition of FLGs. Through Tafel extrapolation of the electrochemical polarisation curves and evaluation as a function of the addition of FLG and MA times, the corrosion parameters, such as corrosion current density, corrosion potential, and corrosion resistance, were determined.



CHANGE IN FRICTION COEFFICIENT OF Cu15Ni8Sn MATERIAL IN DRY AND OILY ENVIRONMENT ACCORDING TO CASTING METHOD

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There are many plain bearing materials used commercially in the industry. Copper alloys are also included in these materials and the most used copper alloy as bearing material is bronze. Cu15Ni8Sn alloy, also known as C96900, is a spinodally hardened alloy and exhibits very good bearing properties in both lubricated and dry sliding conditions. Because of their excellent properties, these copper alloys are found in a wide variety of applications as bearing materials, especially in the aerospace and mining industries. There are many different casting methods for the C96900 material. In this study, C96900 material was produced by two different casting methods, permanent mold casting and centrifugal casting. Solution and spinodal hardening heat treatments were applied to both materials according to the TX00 standard at the temperatures we obtained from our previous scanning and achieved optimum values. Pin-on-disc wear tests were carried out on the heat-treated samples using 440C stainless steel (60 HRC) balls with a diameter of 6 mm, at a speed of 0.30 m/s under 2 N force, in dry and oily environments. An oil with a viscosity of 200 cSt was used for the oily medium. According to the casting method, the hardness, electrical conductivity, and friction coefficients of the samples in dry and oily environments were examined comparatively.





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MULTI-MATERIALS 3D PRINTING OF CERAMICS

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3D printing of ceramics has shown an exceptional growth both in industry and research. Different technologies are today available to shape layer by layer ceramics of various composition: concrete, geopolymers, technical ceramics (oxides, carbides and nitrides) and glass so as it is possible to print from the large to the micron scale selecting the appropriate technique.

Multi-material 3D printing is one of the next evolutionary steps in AM that will further improve the degree of freedom in design and the production of novel components with tailored functionalities. The use of different materials to build 3D parts in one process has effects on the whole process chain, starting from the pre-process to the building process itself where specific technological implementations are requested. The combination of metals and ceramics in one component represents a well-known demanding technological challenge especially if the production is designed in one step, such as 3D printing: metal and ceramic must be properly selected to grant appropriate bonding upon sintering, avoid unwanted secondary phases, cracking, and residual porosity.

Examples of metal-ceramic 3D printed components will be presented with a specific focus on extrusion- based 3D printing technologies.



SYNTHESIS OF Li_4SiO_4 AS A SOLID SORBENT FOR CARBON CAPTURE VIA SOLUTION COMBUSTION ROUTE

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Li_4SiO_4 is a critical material for both CCS technologies and fusion reactors. Conventionally and commercially Li_4SiO_4 is synthesized via solid-state synthesis. This technique requires very high energy consumption to heat up the reactant materials (Li_2CO_3 and SiO_2) resulting in synthesized powders having very large particle size and crystallite size. Combustion synthesis methods provide synthesized ceramic powders with low energy requirement and in nano-size. With this study, Li_4SiO_4 powders as solid sorbent for post-combustion carbon capture were synthesized via solution combustion technique using LiNO_3 as lithium source, TEOS as silicon source and citric acid as the fuel. CO_2 uptake characteristics of the synthesized powders were fully investigated. The sorbent showed a sorption performance as 29.5 wt.% CO_2 uptake value, in thermobalance test under 92 vol% CO_2 (N_2 balance) gas concentration at 600 °C.



DEVELOPMENT OF HOLLOW GLASS MICROSPHERE (HGM)/ GEOPOLYMER COMPOSITE FOR INDUSTRIAL THERMAL INSULATION APPLICATIONS

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In energy-intensive industries, producing inorganic thermal insulation materials with superior properties such as low thermal conductivity ($k < 0.1$ W/mK) and high mechanical properties in terms of adhesion strength is very critical for increasing energy efficiency and therefore reducing total CO₂ emissions. For this purpose, geopolymer-based composites consisting of hollow glass microspheres (HGMs), waste fly ash (FA) and metakaolin (MK) were successfully applied on hot ($T: 300$ °C) metal surfaces without any surface treatment using the spray deposition technique. The effects of Si/Al and Na/Al mole ratios, as well as HGM loading, on the physical, microstructural, thermal, and adhesion strength properties of geopolymer composites were investigated. Electron microscopy studies by SEM and TEM were carried out to correlate the material properties with the HGM-geopolymer interface interaction. Here, the effect of the geopolymer-forming Si/Al mole ratios from 1.5 to 3.5 were investigated. The optimal composition (Si/Al mole ratio 2.5, Na/Al mole ratio 1.0 and HGM loading 10% by wt) produced an HGM/geopolymer composite material with low thermal conductivity ($k < 0.1$ W/mK), strong adhesion strength (> 2.0 MPa), and high stability in water and vibration conditions. The best performing composition produced in a laboratory scale was applied in an industrial pipe having the horizontal and vertical positions. The performance of the thermal insulation coating was followed for 6 months, and no damages were observed in the coating and base metal despite exposure to winter weather conditions. The results indicated that HGM/geopolymer composites have a high potential to be used as thermal insulation materials for equipments with complex geometry in high energy industries.



Nb-Co CO-DOPED BARIUM TITANATE DIELECTRIC CERAMICS FOR MULTILAYERED CERAMIC CAPACITORS

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Niobium (Nb) and Cobalt (Co) co-doped barium titanate (BaTiO₃) ceramics were prepared to stabilize ferroelectric-tetragonal phase transformation of BaTiO₃. Preparation of ceramics started with mixing BaTiO₃, niobium oxide and cobalt oxide powders at predetermined concentrations varying from 1 to 3 atomic percentage. The mixing was done at wet conditions using distilled water with alumina balls at 50 rpm for 24 h in a ball mill. Then, the mixtures were compacted into 15 mm diameter and 4 mm thick disc shaped pellets by uniaxial pressing at 150 MPa. After that the discs were sintered at various temperatures ranging from 1230 °C to 1290 °C for various durations ranging from 30 min to 4 h. Sintered pieces were characterized using XRD, SEM, EDS, and DSC characterization techniques. Electrical properties namely dielectric constant, dielectric loss and temperature coefficient of capacitance were measured. Experimental results revealed that the co-doping of BaTiO₃ with Nb and Co lead to broaden permittivity peaks and temperature stability. A high dielectric constant of 3258 at 1 kHz is obtained at room temperature, along with +%10 and -%17 variation over temperature ranging between -30 and +150 °C. Also, the dramatic change in crystal structure of BaTiO₃ at 10 °C and 121 °C is suppressed.



PRODUCTION OF ACTIVATED CARBON FROM OLIVE SEED

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In this study, activated carbon has a surface area of over 600 m²/g was produced from olive seeds with a single process in two steps of carbonization and physical activation process, which have a minimal economic and environmental impact.



THE USE OF OLIVINE IN THE PRODUCTION OF MINERAL WOOL

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The rapid development and industrialization of mineral wool insulation material started in the early 20th century with the ability to produce two distinctive features, low density and high porosity. Mineral wool can be produced in different forms according to its intended use such as a blanket, pipes, exterior wall insulation, and board. The general features required to meet the intended use of mineral wool in all its forms are energy saving or thermal insulation, fire prevention, sound absorption and noise reduction on the applied surface. Olivine, $(Mg^{2+}, Fe^{2+})_2SiO_4$, is a major component in most basic rocks and it found mostly in the earth's crust. Olivine has attracted great interest as a potential material for various industrial applications such as the hot metal and refractory industries due to its chemical compositions (MgO and SiO₂ contents), low-cost, high refractoriness and low thermal expansion, thermal shock resistance and high chemical stability, etc. Hot metal industries are one of the major consumers of olivine products which are widely used for slag conditioner, molding sand, tap hole filler, and coating materials. In refractory industries, it is particularly used as a raw material to produce forsterite refractories, to manufacture cordierite kiln by addition of clay system, in silo burners lined with its sand. Besides, the high liquidus temperature of olivine provides a heat insulation material with a high temperature resistance, making olivine superior to asbestos wool for utilization in eco-friendly mineral wool. Olivine, which is extracted as a by-product with chromite ore, is a material that has the raw material potential for mineral wool applications with its high MgO and SiO₂ contents (86-89%) and low iron content. In this contribution, we investigate the potential use of olivine and its opportunities for thermal insulation in the safe and efficient manner of mineral wool.



THE UTILIZATION OF CITRATE GEL METHOD IN COBALT BORIDE SYNTHESIS

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Studies on cobalt boride have been extensively performed for corrosion and wear-resistant surface coating. Recently, cobalt boride nanoparticles have drawn attention as a significant potential catalyst for hydrogen storage and fuel cell applications. Size, size distribution, shape, and agglomeration state of the synthesized powder have a significant impact on the microstructure and final properties of the materials. In the conventional wet chemistry methods, cobalt boride nanoparticles with narrow size distribution and controlled shapes can be successfully synthesized. In the present study, a cobalt salt (either $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ or $(\text{CH}_3\text{COO})_2\text{Co} \cdot 4\text{H}_2\text{O}$) as the cobalt source, boric acid (H_3BO_3) as the boron source, and citric acid ($\text{C}_6\text{H}_8\text{O}_7$) as a chelating agent were used. The characterization analysis of powders by XRD, FTIR and SEM will be presented.



EFFECT OF HOT ISOSTATIC PRESSING ON DENSIFICATION, MICROSTRUCTURE AND ELECTRICAL PROPERTIES OF Mg_{0.95}Ca_{0.05}TiO₃ CERAMIC

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The effect(s) of hot isostatic pressing (HIP) on densification, microstructure, and electrical properties of Mg_{0.95}Ca_{0.05}TiO₃ (M0.95CT) ceramic was researched. M0.95CT ceramic was prepared by the conventional mixed oxide method. The powder mixture of the oxide components in appropriate molar ratios was compacted in a stainless steel die by double action pressing. The square shaped compacts with nominal dimensions of 35 mm in size and 4 mm in thickness were pressureless sintered in air at temperatures of 1300, 1350, and 1400 °C. HIP sintering was applied on the pressureless sintered ceramics at ~1200 °C for 1 h. The differences on the characteristics and electrical properties of M0.95CT ceramic was evaluated on the samples produced by application of HIP and without HIP. Results revealed that HIP sintering has a profound influence on densification, microstructural development, and electrical properties especially on insulating behavior of M0.95CT ceramic.



PRODUCTION AND CHARACTERIZATION OF CERAMICS FOR MICROWAVE APPLICATIONS

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New research and developments on microwave communication result in a rising demand for dielectric resonators used in wireless communication devices. Dielectric oxide ceramics are used as filters, oscillators in a variety of applications from mobile phones to global positioning systems. It has also played an important role in the microwave wireless communications industry by reducing the size and cost of antenna components. The essential properties for a dielectric resonator are high dielectric constant (ϵ_r), high quality factor (Q) and near-zero temperature coefficient of resonance frequency (Δf). In this study, dielectric ceramic compositions (e.g., MgNb_2O_6 , $\text{Ba}_2\text{Ti}_9\text{O}_{20}$, $0.68\text{CaTiO}_3\text{-}0.32\text{Ca}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{O}_3$ and $\text{Ba}_{6-3x}(\text{Nd}_{1-y}\text{Bi}_y)_8+2\text{Ti}_{18}\text{O}_{54}$ $x=2/3$ and $y=0.07$) with various dielectric constants were synthesized by solid state method and successfully fabricated by dry pressing for microwave resonator applications. Densification and phase formation were investigated for each composition sintered at least 3 temperatures to optimize dielectric properties. All sintered samples had a relative density $>97\%$. Dielectric constants at optimum sintering temperatures for each composition were 20.27 for MgNb_2O_6 , 39.20 for $\text{Ba}_2\text{Ti}_9\text{O}_{20}$, 89.63 for $0.68\text{CaTiO}_3\text{-}0.32\text{Ca}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{O}_3$ and 90.83 for $\text{Ba}_{6-3x}(\text{Nd}_{1-y}\text{Bi}_y)_8+2\text{Ti}_{18}\text{O}_{54}$ $x=2/3$ $y=0.07$.



PHASE ANALYSIS AND DIELECTRIC CHARACTERISTICS OF BST CERAMICS PRODUCED BY CONVENTIONAL AND MICROWAVE ASSISTED SOLID-STATE REACTIONS

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Ferroelectrics like $\text{Ba}_{1-x}\text{Sr}_x\text{TiO}_3$ (BST) draw great attention for applications in tunable devices such as antennas, frequency-selective surfaces (FSS) and tunable filters that are commonly used in electronics industry. In this study, the effect of Sr content and heating method on lattice parameters, volumetric phase percentages (tetragonal ferroelectric and cubic paraelectric) and tetragonality factor (c/a) were extensively investigated using X-ray diffraction (XRD). Individual lattice parameters, volumetric phase percentages and tetragonality factors were calculated using Rietveld refinement software MAUD for both tetragonal ferroelectric phase and cubic paraelectric phase of BST. Ferroelectric to paraelectric phase transition temperatures of the samples were determined using differential scanning calorimetry (DSC).



EXPERIMENTAL PHASE STUDIES IN THE QUASI-BINARY BaCeO₃-SrCeO₃ SYSTEM

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In recent years, ceramic oxides with the structure of the perovskite have gained considerable attention due to their technological applications in fuel cells and oxygen permeable membranes. The BaCeO₃-SrCeO₃ solid oxide solution exhibited exemplary behavior in ionic conductivity-driven applications. The structure, stability and phase formation in the system control the materials properties. In the literature, limited phase stability data is available, therefore, this work aims to investigate the mutual solubility in the BaCeO₃-SrCeO₃ quasi-binary section at various temperatures.



EFFECT OF h-BN AMOUNT ON Al_2O_3 /GLASS COMPOSITES FOR LTCC APPLICATIONS

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(SiO_2 - Al_2O_3 - CaO)-based glass (55 wt% glass)/ceramic (45 wt% Al_2O_3) composites with nano-hBN (0-10 wt%) addition were investigated. Al_2O_3 /glass/hBN composites were fabricated for the LTCC applications. Alignment and homogeneous distribution of the platelet hBN particles during tape casting allowed high hBN (5 wt%) loading as well as facilitated densification at 800°C (density of 2.65 g/cm³, apparent porosity of 0.7%). Dielectric constant of the dense composites decreased (or, alternatively, enhanced) with increasing hBN content from 7.3 for the 0 wt% hBN to 6.55 for the 5 wt% hBN at 5 MHz. In addition, hBN addition strongly improved the mean thermal conductivity from 1.86 W/m•K for the 0 wt% hBN to 2.43 W/m•K for the 5 wt% hBN between 75°C and 250°C.



METHYLENE BLUE REMOVAL BY PHASE SEPARATED POROUS GLASS

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In this study, it was aimed to utilize Porous glass (PG) as an adsorbent in MB removal from wastewater. PG powders were produced by melting and phase separation of an alkali borosilicate glass followed by selective leaching in HCl and an additional alkali treatment. The scanning electron microscope and N₂ adsorption/desorption techniques were applied to characterize the pore architecture of the PGs. Methylene blue (MB) adsorption efficiency was investigated from the change in MB concentration in the MB aqueous solutions with various concentrations through the absorbance of the solution at a wavelength of 664 nm monitored on a UV-Vis spectrometer. Results showed that the structure and textural properties of PG was evidently altered via alkali treatment hence affected its adsorption performance. The maximum adsorption capacity for alkali treated PG in the concentration ranges studied was 60.6 mg/g. The isotherm analysis indicated that the equilibrium data were well fitted to the Freundlich isotherm model.



VALUABLE SOURCES OF RAW MATERIAL FOR ACTIVATED CARBON; HAZELNUT HUSK AND PUMPKIN SHELL

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Hazelnut husk (HH) and pumpkin shell (PS) wastes, formed after agricultural activities and processing in the Sakarya region in Türkiye, are generally disposed via burning illegally. Finding an economical and environmentally friendly disposal method such as converting them into value-added product / activated carbon (AC) might be a good alternative solution for their disposal problem. Within the scope of this study, HH and PS wastes were tried to be converted with a low cost, easy and environmentally friendly method to activated carbon, as an alternative to commercially produced AC products.



THE EFFECT OF SINTERING PARAMETERS ON THE PROPERTIES OF IR TRANSPARENT ZnS PRODUCED BY SPARK PLASMA SINTERING

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In this study, spark plasma sintering (SPS) was used to produce optical grade zinc sulfide (ZnS), by using different temperatures, times and pressures. Sintering temperature was between 750 and 900 °C, sintering time was between 5 and 10 minutes and pressure was increased from 16 MPa to 50 MPa between two steps. The results showed that SPS can effectively be used in optical grade ZnS production when these SPS parameters were optimized. As far as the results of this study is concerned, optimum sintering temperatures seem to be around 850 °C with relatively short sintering times. Microstructure analysis revealed that grain size has remained rather small around 1-8 μm , which might contribute to mechanical property improvement. Optical transmission values were found to vary with specimen thickness and ranged from 15 to 63% within the 3-12 μm infrared wavelength spectrum, depending on sintering time and temperature. Selected samples hot isostatic pressed (HIP) after SPS have shown that HIPing has resulted in a significant improvement on optical transmission, reaching 75% transparency.



IMPROVEMENT OF OXIDATION RESISTANCE OF CARBON FIBER WITH Bn-B₄C COATINGS

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In order to improve the oxidation resistance of carbon fibers, a B₄C and BN-B₄C multilayers coatings were deposited with a chemical vapor deposition process by generating boron oxide gas species (BO-CVD). The samples were characterized by XPS, SEM, XRD, FTIR and RAMAN. The oxidation behavior of B₄C and BN- B₄C coated carbon fibers was evaluated using DTA/TG with flowing air up to 1500 °C.



SYNTHESIS OF B_4C - Al_2O_3 COMPOSITE POWDER VIA ALUMINOTHERMIC REDUCTION

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Boron carbide (B_4C) is one of the well-known hardest materials used in industrial applications but it has some limitations in sintering. B_4C has poor densification ability because of its strong covalent bonds, low plasticity, and high resistance to grain boundary sliding. Therefore, high temperature and/or pressure are required for fully dense B_4C products and this process is costly. To overcome this disadvantage, aluminum oxide (Al_2O_3) can be added to the B_4C sintering powder for improving the densification ability of B_4C significantly, and also the addition of B_4C to Al_2O_3 increases hardness and fracture toughness by grain boundary pinning effect. In our study, we investigated the in-situ synthesis of B_4C - Al_2O_3 composite powder via aluminothermic reduction by examining the mechanism between aluminum and raw materials used in B_4C synthesis. Boron oxide (B_2O_3) carbon black, and metallic aluminum were used as reactants. The raw materials were mixture and the prepared mixtures were homogenized by a horizontal roller ball milling. The homogenized powders were pressed into cylindrical pellets and placed into graphite crucibles with perforated lids. The pellets were subjected to heat treatment in a controlled atmosphere furnace at 1400-1600 °C for 3 hours with an argon gas flow rate of 3l/min. As a result, the phases and microstructures of final products were characterized and B_4C - Al_2O_3 composite powder was synthesized.



DEVELOPMENT OF ALUMINIUM OXIDE CASTABLE COMPOSITE REFRACTORY AND PRODUCTION BY SOL-GEL PROCESS

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This study was carried out for the development of Castable Aluminium oxide-based Composite Refractory with Sol-gel method. Self-flow refractories have been studied in terms of general application and product properties. This project was carried out together with Metamin Mümessillik Sanayi ve Ticaret A.Ş. as a university-industry cooperation. The study consists of theoretical and experimental parts. The physical, mechanical, chemical and thermal properties and their processing and bonding mechanisms are the most important parameters that determine the castable refractory properties. Calcium aluminate cement (CAC) is the most preferred binder in the production of castable refractories. When this binder system (CAC) is used, alternative binder system researches are carried out due to reasons such as low melting temperature phases and reduced refractoriness, difficulty in drying because it contains chemically bound water. As a result of these studies, Colloidal Silica was preferred as a binder due to its advantages such as not forming melting phases at low temperatures, providing ease of drying because it does not contain chemically bound water, and supporting the formation of mullite by reacting with reactive alumina, thanks to its very fine-grained silica oxide. On the other hand, as a binder system, Mono aluminum Phosphate (MAP) and Silanyl additives are added separately to minimize these risks, as a result of literature studies, to be developed. The interactions of these two different additives with Colloidal Silica were investigated. In a reference recipe selected as self-flow castable, the mixtures prepared by adding the said additives in certain proportions were prepared by pouring them into cubic samples. Various physical properties of the obtained refractory samples were investigated and systematic experimental studies were carried out to determine the optimum additive ratios.



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THE EFFECT OF IRON CONCENTRATION IN ELECTRODEPOSITED SOLUTION AND PH OF ELECTROLYTE ON PHOTOELECTROCHEMICAL HYDROGEN PRODUCTION EFFICIENCY OF HEMATITE (α -Fe₂O₃) PHOTOANODE

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In this study, photoelectrochemical performance (PEC) of Hematite (α -Fe₂O₃) photoanode, fabricated with thermal oxidation of electrodeposited iron at 450 °C for 24 hrs. was investigated. The effect of iron concentration (0.02M, 0.04M and 0.06M FeSO₄·7H₂O) in solution of iron sulfate, boric acid (H₃BO₃), and sodium sulfate (Na₂SO₄) on the PEC performance of the hematite photo anode were studied. The PEC characterization of hematite (α -Fe₂O₃) was carried out with I-V, photo voltage, PEIS, and Mott Schottky analysis in 0.1 NaOH (pH=13) solution. The best photo current of 0.22mA/cm² at 0.6 V vs. SCE was found for 0.04M FeSO₄·7H₂O the sample with 50 sec. coating time at pH 13 after optimization of Fe concentration and coating time because of determined higher donor density of 40.3x10¹⁸ cm⁻³. Photo current measured for different pH such as 7, 11, 13 and 14 were respectively 0.02, 0.11, 0.16 and 0.21 mA/cm² at 0.6 V vs. SCE. As the pH increased the photo current density increased.



THE THERMOCHEMICAL HEAT STORAGE PROPERTIES OF COMPOSITE STRUCTURES PRODUCED DIFFERENT MATRIX AND SORBENT SALTS

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Thermochemical Heat Storage (THS) systems have a lot of attention for heat storage with the development and improvement of composite materials as storage mediums. In this study, composite materials were prepared by impregnating sorbent salt (CaCl₂, LiCl) into three different matrix materials as anodic aluminum oxide (AAO) template, vermiculite (V) and pumice (P). The cyclical heat storage behaviors of the obtained composites were investigated with the laboratory scale thermochemical heat exchanger prototype system and heat storage behaviors of different salts impregnated with different porous host materials were compared.



ADVANCED MATERIAL SOLUTIONS FOR SAFER AND LONG- LASTING HIGH CAPACITY COBALT FREE BATTERIES FOR STATIONARY STORAGE APPLICATIONS (CoFBAT)

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The CoFBAT project aims to use LNMO cathodes, Si or metal oxide-based anodes and a gel type electrolyte to improve the power performance, energy density (750 Wh/L), lifetime, safety, recycling and reduce the cost (0.03 €/kWh/cycle) of the batteries. CoFBAT combines the expertise of material development, battery science, largescale battery producers, life cycle assessment and recycling by combining Multiphysics based continuum scale modelling with experimental validation and manufacturing of battery cells.



MATERIAL SUPPLY RISK FOR THIN FILM SOLAR CELLS AND IMPORTANCE OF RECYCLING

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This research focuses on two crucial points; the metal need of the thin film PV industry and their impacts on the market and recycling of these metals from manufacturing and end-of-life waste. The analysis clearly showed that silver, indium, and gallium supplies are the bottlenecks of the industry due to resource limitations and the importance of the other industrial applications of these metals. Considering recycling of copper-indium-gallium-diselenide thin-film solar cells, hydrometallurgical approach is the only direction for the recovery of critical and valuable metals. One step acidic leaching results indicate that 100% Ag and 55% In extractions are possible, but purification stages are needed to reuse the metals in the PV industry.



AN INDUSTRIAL ECOLOGY PERSPECTIVE OF BATTERY TECHNOLOGIES FOR ELECTROMOBILITY: LCA OF SOLID-STATE LIS BATTERY

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This study investigates the sustainability of an emerging lithium-based battery technology (i.e., lithium sulfur battery, LiS) from the perspective of industrial ecology. According to the results, the use of argon and sulfuric acid in the production of LiS pouch cells may cause adverse environmental impacts.



ELECTROCHEMICAL NOISE MEASUREMENT IN BATTERIES WITH METALLIC LITHIUM ANODES

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Electrochemical noise measurements are well known in corrosion literature. From the measurements, it is possible to identify the mode of corrosion and distinguish between localized corrosion types and the uniform ones when it is analyzed in conjunction with post-mortem studies. In recent years, the increase in the use of lithium-ion batteries demands that the tests to be performed on the batteries are faster, easier, cheaper and, if possible, non-destructive and non-perturbing. Although some electrochemical noise studies have begun to be carried out on batteries, the literature on this subject is scarce and questionable. Electrochemical noise measurement of Li batteries can be ultimately used as a non-invasive tool to diagnose the battery health and we have already shown that non-rechargeable batteries with Li/MnO₂ chemistry shows increase in voltage noise after being exposed to a short circuit.

As a result, morphological changes on metallic lithium can be detected by electrochemical noise measurements and this method can be used as non-invasive diagnosis tool.[1] Lithium metal-based chemistries have a much higher capacity than rechargeable chemistries because of the use of Lithium-aluminum alloy in rechargeable chemistries, as opposed to metallic Lithium used at the anode. It is known that charging of lithium metal electrode to result in the formation of lithium dendrites. These dendrites can disrupt the separator separating the anode from the cathode, exposing the battery to a short circuit or even causing the battery to burn or explode. For this reason, the pre-detection of any potential dendrite formation is both academically interesting and industrially important. Some preliminary studies show that noise level increase drastically after charging.

Moreover, the anodes of the charged batteries were also examined with SEM and serious deterioration was observed in the anode of the battery after charging. Just like noise measurements on non-rechargeable batteries with lithium chemistry exposed to short circuits, it is worthy to study on and develop pre-detection method for in lithium batteries that are prone to form dendrite during charging and discharging cycles by using electrochemical noise measurements.

For this reason, we also conduct noise studies with symmetrical and asymmetric cells (Li/Li, Cu/Cu and Li/Cu) prepared in the glove box and examine the details of the noise increase in a controlled and detailed manner. In this talk, we will discuss details of electrochemical noise of metallic lithium-based batteries. These details involve measurement methods, reasons for increase and sources of the noise. We will present both noise measurements and imaging with optical microscope in situ and post-mortem with spectroscopic analysis.



INVESTIGATING THE ELECTROCHEMICAL PERFORMANCE OF DOUBLE SHELL CATHODE ACTIVE MATERIALS FOR LITHIUM ION BATTERIES

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The increasing effects of global warming force humans to decrease their carbon footprint and CO₂ emissions in all fields. Transportation makes up a large part of the carbon footprint. In this field, electric cars provide an opportunity to fulfil this aim [1]. Producing a rechargeable battery with high performance, long cycle life and capacity retention is the aim of many researchers. As the limiting factor of performance in lithium-ion batteries, cathode active materials with desired properties must be developed [2]. In this study, lithium nickel cobalt manganese oxide (NMC) as cathode active material is synthesized via co-precipitation method. The active material composition is designed to be in double shell structure as NMC 811/721/622 and 811/622/111 for core, inner shell, and outer shell, respectively. The change in composition is obtained by modifying the stoichiometry of the transition metal solution. NaOH solution is used as a precipitating agent and NH₄OH solution is used to adjust the chelating agent. The precipitate is collected and mixed with LiOH, then calcined at 500 °C for 6 hours and at 850 °C for 12 hours. The structural characterization of synthesized active materials is examined by XRD analysis, the electrochemical performance is investigated by galvanostatic tests, cyclic voltammetry, and impedance analysis.



COMPOSITE ELECTRODES PRODUCTION USING NICKEL-TITANIUM ORTHODONTIC WASTE AND INVESTIGATION OF THEIR USES IN LITHIUM ION BATTERIES (LIBS)

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Limited metal deposits on Earth and a rise in energy prices cause the value of the metals, produced by the primary method, to be increased continuously in the metal market. Therefore, instead of primary production, recycling and recovery become more important. Hence, an example of a high-value-added composite fabrication from waste material is given in this article. Over the past few decades, nickel-titanium alloys have gained enormous fame, in the field of biomedical engineering, due to their strength, biocompatibility, high corrosion resistance, and shape memory effect. Metallic waste generated as a result of biomedical treatments comprises more than 25% nickel-titanium waste. This waste contains 45%-50% nickel and 50%-55% titanium. The values can be recovered from biomedical waste and can be utilized as energy storage material in lithium-ion batteries (LIB) by following a careful designed. Herein firstly leaching of the nickel-titanium orthodontic wires with sulfuric acid has been maximized. Then by Ph adjustment, selective recovery of TiO₂ rich and NiO rich powders has been achieved. In the last step by high energy ball milling these two oxide powders (TiO₂ rich and NiO rich powders) in 1/6 ratio a composite powder has been fabricated. All of the fabricated powders were characterized structurally, chemically, and morphologically. The possible use of each powder was studied as anode material in lithium-ion batteries based on their potentiostatic and galvanostatic test performance. This study defines another way to coop with biomedical waste efficiently as it shows that it is possible to evaluate them in high value added application, i.e. negative electrode for LIBs.



MODULATION OF CATION COMPOSITION FOR LITHIUM STORAGE OF SPINEL-STRUCTURED HIGH ENTROPY OXIDES

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Various high entropy spinel oxides with non-equimolar composition have been produced via co-precipitation method with the purpose of investigating lithium storage capability and electrochemical behavior. Acquired results were compared in terms of electrochemical performance.



INVESTIGATION OF NI EFFECT ON MN-FE-BASED MULTI-TRANSITION METAL LAYERED CATHODE MATERIALS FOR SODIUM-ION BATTERIES

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In this study, Ni-doped NaMnFeAlO_2 cathode materials with different stoichiometric ratios were synthesized successfully by a modified solid-state technique using high purity oxide powders. X-ray Diffraction (XRD) and Scanning Electron Microscope (SEM) are used for structural analyses of the materials. Galvanostatic charge-discharge tests, Cyclic Voltammetry (CV), and Electrochemical impedance spectroscopy (EIS) are used for electrochemical characterization of cells. Based on the results, better capacity was obtained with Ni-doping than that of the undoped composition.



THE EFFECT OF IMPREGNATION CONDITIONS ON ACTIVE METAL SIZE AND DISTRIBUTION PROFILES OF Ni/Al₂O₃ SUPPORTED CATALYST

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The impregnation step in the manufacturing process of shaped catalysts strongly effects the final quality of the catalyst, which depends mainly on the specific impregnation method and the drying conditions. The distribution of the metal nanoparticles within the porous support critically affects the performance of shaped catalysts. This study investigates the effects of varying impregnation conditions on active metal dispersion profiles of spherical-shaped γ -Al₂O₃ supports impregnated with Ni catalysts by incipient wetness and wet impregnation methods. In order to understand the effect of impregnation conditions on catalyst properties, the Ni/Al₂O₃ shaped catalysts were investigated via SEM-EDX, XRD, XRF, TEM, FTIR and TPR analyses.



TEMPERATURE-DEPENDENT GALVANOSTATIC EIS OF SPIRAL AND BOBBIN Li/SOCl₂ BATTERIES

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Electrochemical Impedance Spectroscopy is an in-situ and non-destructive analysis method for studying the characteristics of electrochemical systems. When combined with a temperature-dependent experimental environment, it can reveal the thermodynamic and kinetic properties of electrochemical processes in batteries. One of Li batteries' most fundamental and critical aspects is the Li oxidation and transportation of Li⁺ to the electrolyte through the Solid Electrolyte Interface (SEI). Further investigation of these properties unravels the optimization and development of the Li anode research of the future. For this purpose, we have investigated various battery types and chemistries to understand the Li⁺ transport through the SEI, specifically with metallic lithium anodes. Equivalent circuit fits were done on the obtained EIS spectra to characterize these processes. After that, the resistances were plotted inversely to achieve an Arrhenius relation with respect to the temperature. The slope of these plots can lead to the Activation Energies (EA) of different electrochemical processes. Among these, the transportation of Li⁺ through the SEI is investigated. Investigations of these processes also include the passivation layer, which forms when metallic Li anode contacts with a reactive electrolyte/solvent. We have also shown that this layer can be formed immediately after the measurements and demolished with a high current discharge before each measurement. This passivation layer enables certain battery types to have an extremely long shelf life. Our results show that the transport processes are clearly non-Arrhenius, indicating the complexity. We will be presenting our results that reveal the details of Li⁺ transport across the SEI.



AN INNOVATIVE APPROACH FOR ELECTROLYTE RECYCLING FROM LITHIUM-ION BATTERIES

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In this study, electrolyte recovery was investigated by two different processes which are low temperature pyrolysis and supercritical CO₂ to compare the recovery efficiencies and effectiveness of the process. The results showed that dimethyl carbonate (DMC), ethyl methyl carbonate (EMC), and ethylene carbonate (EC) were successfully recovered by low temperature thermal treatment. However toxic exhaust gases, hydrogen fluoride (HF), and phosphoryl fluoride (POF₃), due to the decomposition of LiPF₆ were detected. On the other hand, DMC and EMC were effectively recovered by the supercritical CO₂ method and no toxic compound formation was observed.



IMPROVING THE STABILITY OF POLY (ETHYLENE OXIDE) BASED GEL POLYMER ELECTROLYTES FOR HIGH POTENTIAL LiNiMnCoO_2 CATHODE APPLICATIONS

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PEO-based solid electrolytes are one of the featured candidates to overcome the safety concerns of commercialized Li-ion batteries (LIBs) with liquid electrolytes. Although PEO-based electrolytes are stable enough for only low-voltage cathode candidates such as LiFePO_4 , this limits the electrolyte usage in the higher potential cathode applications such as LiNiMnCoO_2 (NMC). In this study, we improved the electrochemical stability window (ESW) of the PEO electrolyte (PE) by modifying the EO backbone, which is unstable over the 3.8 V. Re-architected polymer electrolyte system represents a higher potential stability window and is compatible with the NMC high potential cathode applications.



A FREE-STANDING BIO-DERIVED POROUS CARBON COMPOSITE AEROGEL CATHODE TOWARDS HIGHLY STABLE LITHIUM-OXYGEN SYSTEMS

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Lithium-O₂ battery (LOB) is the most appealing rechargeable battery for electric vehicles and energy storage devices because of its high energy density. In LOB systems, the cathode structure plays an essential role by accommodating discharged products while providing a free passage for oxygen, electron, and Li ions transfer.

Therefore, in this study, we present a sustainable technique to fabricate a free-standing porous carbon aerogel loaded with noble metal nanoparticles by pyrolyzing biomass cellulose aerogel as a carbon source and template. These lightweight porous frameworks show great mechanical properties with elastic modulus up to 90% compression. The porous framework of the cathode offers transport pathways as well as sufficient space for product storage. Moreover, the loaded metals perform as catalytic sites to allow rapid oxygen reduction/evolution reactions. Besides, the parasitic reaction generated by the binder is inhibited, and electron transport is boosted. Consequently, the prepared cathode exhibits improved electrochemical properties, such as high capacity, low over-potential, and excellent cycling stability (310 cycles). The high stability is believed to be due to the 3D porous structures and preventing parasite reactions associated with the binder.



GRAPHENE-BASED NANOCOMPOSITE CATHODE MATERIAL FOR LITHIUM ENERGY STORAGE

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The next generation of energy storage is the Li-O₂ batteries due to their high theoretical energy densities (11,140 Wh/kg). The combination of Li-O₂ batteries usually contains a porous cathode, an anode made of pure metallic lithium, a solid separator, and an electrolyte with lithium salt dissolved in a non-Protic solvent. The electrochemical reaction involves oxygen reduction (ORR) and oxygen evolution reactions (OER). During the discharge process, the oxygen (which comes from the outside air) is reduced at the cathode, where it reacts with Li⁺ released from the anode to form Li₂O (4Li⁺ O₂ → 2Li₂O) or Li₂O₂ (2Li⁺+O₂→Li₂O₂). However, Li-O₂ batteries suffer from a short life cycle, low charge/discharge rate, and energy efficiency. Cathode catalysts play an important role in enhancing the electrochemical process of Li-O₂ energy storage to overcome the aforementioned obstacles. Therefore, it is necessary to design a cathode with a porous texture, chemically stable, highly conductive, and high catalytic activity.

In our study, we have synthesized Ru and α-MnO₂ nanoparticles anchored on reduced graphene oxide (rGO) as cathode material to enhance the performance of Li-O₂ energy storage. Despite the fact that noble metals can cover a remarkable role in developing the bifunctional stability and activity of OER/ORR, their high price and rare ore hinder scale-up synthesis; hence we have utilized MnO₂, which is a good catalytic activity with low cost.

Our findings showed that the assembly of bifunctional catalysts, as well as Ru and α-MnO₂ on graphene nanosheets, can decrease the formation of side reactions of discharge products, enhance catalytic activity, and reduce charge potential.



CELLULOSE-BASED GEL POLYMER ELECTROLYTES FOR ALL SOLID-STATE BATTERIES

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Recently, natural materials are widely used in energy storage areas due to their environmental friendliness and low cost. In this study, we report biodegradable cellulose-based highly ionic conductive gel polymer electrolytes. Cellulose gel polymer electrolyte shows good electrochemical performance at room temperature, including high ionic conductivity and high lithium-ion transfer number. These results show a very promising direction for a low-cost and renewable gel polymer electrolyte for lithium-ion batteries.



FAHTS

Failure Analysis and Heat Treatment Symposium

Hasar Analizi ve Isıl İşlem
Sempozyumu





DETERMINATION OF THE AUSTENIZATION TEMPERATURE VIA COMPUTATIONAL METALLURGY APPROACH FOR AN ALLOYED DUCTILE IRON

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Normalization heat treatment which should be performed slightly above the Acm temperature generally has a homogenization, grain refinement and relaxation effect on the ferrous materials. Furthermore, for a ductile cast iron this, treatment may also alter the phase fractions as like the pearlitic-ferritic microstructure. Tuning the phase fractions may have some crucial effects in specific processes as in the case of induction hardening. In this study, an alloyed ductile iron grade was inspected with the quantitative metallography approach and the success of the normalization heat treatment was assessed by the final microstructure. In particular, the initial ferrite volume fraction was tried to be decreased. To perform the normalization, the needed austenization temperature was calculated with computational metallurgy approach which was decided to be a more proper solution instead of using some conventional rule-of-thumb methods.



THE DAMAGE ANALYSIS OF THE DIAMOND PARTICLE IN THE CUTTING NATURAL STONE PROCESS

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Natural stone production in open mining is carried out in the form of cutting the natural stone from the bedrock with different methods and reducing it to the desired dimensions. The diamond cutting wire and saws are the newest and most advantageous method, which has the most application area among the block natural stone production methods. The segments are composed of binder, diamond grain and metal matrix and the segments are prepared with powder metallurgy process. There are many geological and physico-mechanical factors affecting the field performance of the diamond cutting tools; machine power, hardness and abrasiveness of the stone to be cut, operator experience, diamond segment design and production technology. In addition to these parameters, the most important factor affecting the cutting performance is the selection of the metal matrix composition of the diamond tools and the determination of the properties of the diamond such as concentration, grain size and coating type. During stone cutting, contacting between diamond grits and stone surfaces is obvious that it results in on impact force on diamond grits. By liquid in the environment that carries hard abrasives of tiny rock detritus, erosive wear occurs on metal binder surfaces in diamond tools. The diamonds is subjected to varied forces during the sawing process and the diamonds get damages under the load. The damages of the diamond grit can be classified into three categories; micro-fractured diamond grits, abrasion diamond grits and pulled-out diamond grits. The aim of this study determine the effects of the concentration of the diamond for controlling the damages, reducing wear of segments, increasing life and precision machining of the diamond tools. In this study, two different diamond concentrations were determined C42 and C75 and the metal matrix is chosen cobalt based. The microstructures of the samples were examined by scanning electron microscope (SEM) and X-ray diffraction (XRD) analysis. The density and hardness of the samples were determined. The field performances of the samples were examined at cutting marble stones. After the field tests, the diamonds were investigated by SEM. It was observed that the serving life of the diamond cutting tools was increased with increasing diamond concentration. The diamond damage was observed much more intensely at lower diamond concentration.



INVESTIGATION OF EPDM MATERIALS USED IN MILK TANKER

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In this study, it was conducted to investigate the ideal material for solving the cracking problems of EPDM materials used in long vehicles. The effect of three different Ethylene Propylene Diene (EPDM) materials on the mechanical properties of the material, depending on the change in their chemical content, was investigated. The materials were subjected to X-Ray Diffraction (XRD) analysis in order to determine their chemical composition. Scanning Electron Microscope (SEM) and Energy Dispersive Spectroscopy (EDS) techniques were used to investigate the homogeneous distribution of material contents. Tensile tests were applied to determine the mechanical properties of the materials.



FAILURE EVALUATION OF COMPRESION STEEL SPRING WIRES AND FACTORS AFFECTING BREAKING

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Automotive springs, which are one of the important application areas of compression springs, are safety parts with critical life. In compression springs, provided that it remains in the elastic region of the material, the energy that is compressed and stored due to a force acting in the direction of the spring's axis can be recovered later. These springs, operating under dynamic repetitive loading conditions, must have a certain cycle life. In this study, failure analysis studies were carried out on a 5.30mm and 0.83C steel (EN-10270-1) broken spring, which was cold drawn and then subjected to patenting heat treatment, and the factors affecting the breakage were discussed. Failure analysis studies, internal structural control (segregation, decarburization, capillary crack, inclusion), fracture zone and surface examinations under electron microscopy (SEM-EDX) and hardness measurements, and factors affecting the fracture were investigated after the metallographic preparation of the material. All production stages were observed throughout the study, and as a result, it was concluded that the formation of microcracks on the surface due to the unsuitable or insufficient cold deformation and lubrication conditions in the wire drawing process, the fracture occurred as a result of the development of these cracks with the increasing number of cycles and it had a limited life. It has been determined that the crack that occurs on the wire surface and causes breakage is in the form of a V crack, which is defined as a crow's foot.



INVESTIGATION OF FORGING PROCESS FAILURES AND SOLUTIONS IN THE PRODUCTION OF STEERING AND SUSPENSION SYSTEM PARTS

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Forging process includes metallic material, temperature, mold, lubrication, dimensional, human factor. These factors sometimes constitute an element of their own, and sometimes error modes as an element among themselves. Since these errors can be critical safety parts according to their application, special controls and prevention of these errors occur as an important element for people and other living things. The reasons for the origin of these errors in the forging process are addressed based on the standardization principles in order to eliminate the faults that have been handled one by one and to avoid duplication of these errors.



INVESTIGATION OF THE AA6005-A ALLOY'S CORROSION BEHAVIOR IN DIFFERENT AGING CONDITIONS

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Using a potentiodynamic polarization test in a 3.5 percent NaCl solution, the effects of aging conditions on the corrosion behavior of AA 6005-A were examined in this study. Microstructural investigations and hardness testing supported the results. The potentiodynamic polarization experiments were performed with a scanning speed of 0.5 mV/s at 250 mV below and above the observed open circuit potential values. Using the Tafel curves obtained, the corrosion potential (E_{corr}) and corrosion current (I_{corr}) values were calculated. Vertical direct-chill cast billets (228 mm) were solution heat treated for 2 hours at 550 °C, then water quenched to room temperature. After the solution heat treatment, the samples were aged at 180 °C for 4 hours, 8 hours, and 24 hours. The experimental results showed that varied aging parameters had a significant impact on the alloy's main corrosion characteristics, such as E_{corr} and I_{corr} . Corrosion resistance increased and began late in the over-aged sample. In under-aged sample, corrosion resistance decreased and started early.



FAILURE ANALYSIS OF A BROKEN REDUCER SHAFT

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Reducer shafts may fail for a number of causes sometimes before the expected service period ends. This study is about the analysis work carried out on a broken reducer shaft made from 17CrNiMo6, has failed by breaking into two at a reduced section, showing evident beach marks on the fracture surface, which are typical signs of fatigue failure, at a service period much shorter than expected (2 months for 5 years). Information collected on working conditions evidences, chemical, mechanical and metallographic findings supported us to make an evaluation and gave ideas about how it can be avoidable.



FAILURE ANALYSIS OF A BROKEN DESCALER PUMP SHAFT AT THE HOT STRIP MILL FACILITIES

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Descaler Pump shaft made from DIN 1.4313 martensitic stainless steel, at İsdemir Hot Strip Mill line, has failed by breaking into two at a reduced section, showing evident beach marks on the fracture surface, which are typical signs of fatigue failure, at a service period much shorter than expected (7 months for 5 years) . Information collected on working conditions evidences, chemical, mechanical and metallographic properties supported us to make an evaluation and gave ideas about how it can be avoidable.



INVESTIGATION OF THE AUSTEMPERING DURATION AT 400°C ON SILICON SOLUTION STRENGTHENED DUCTILE IRON

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Silicon Solution Strengthened Ductile Irons (SSSDI)/(EN GJS 500-14), which has been developed in recent years, is an important material in engineering terms due to its advantages such as high yield strength, ductility and machinability. However, the effect of heat treatment processes such as austenitizing-austempering temperature and austempering duration on mechanical properties and microstructure has not been studied sufficiently. In this study, the austempering behavior of a new ductile iron grade material SSSDI has been investigated. Considering the inhibition effect of silicon on iron carbide formation and solution strengthening effect of ductile iron in ductile iron, ductile iron containing wt.3.7% silicon was produced, then austenitizing was performed at 950 °C, followed by austempering processes at 400 °C during 5,15,30,60, 90 and 120 minutes. The austempering capability of this high silicon ductile cast iron was investigated by hardness, tensile tests and OM, SEM, XRD. Austenitization tests have shown that 950 °C is an ideal austenitizing temperature for solid solution strengthened cast iron due to 3.7% Si. It was observed that the tensile strength was 1464 MPa, the hardness increased to 463 HBN and the elongation amount to 4.1. With the increase in austempering time, the tensile strength decreased partially, while the elongation value increased.



CPS

Composite and Polymer Materials Symposium

Kompozit ve Polimer
Malzemeler Sempozyumu





SURFACE MODIFICATION OF GLASS FIBER WOVEN FABRICS BY INDIUM TIN OXIDE COATINGS AND ELECTROMAGNETIC CHARACTERIZATION OF THEIR MULTILAYERED GRADED COMPOSITES IN X-BAND FREQUENCY RANGE

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In this study, the main objective was to develop a guideline for designing an electromagnetic (EM) wave absorbing composite which is a combination of Jaumann and graded type absorber effective in the X-band frequency range (8-12 GHz). Within the scope of this aim, the effects of conductivity and cascading order of indium tin oxide (ITO) coated glass fiber woven fabrics on the electromagnetic properties of hybrid type multilayered graded composite design was investigated. The spray pyrolysis technique was used to deposit ITO sols on glass fiber woven fabrics, and the electrical properties of these layers were varied to achieve the desired amount of EM wave absorption. EM characteristics of the ITO-modified fabrics were measured experimentally using free space set-up in the X-band frequency range, and data obtained from the measurements were introduced to AWR microwave software to design multilayered graded type absorber composites by cascading ITO-modified fabrics with different conductivity gradients. A composite design with the highest performance has been formed by cascading six ITO-modified fabrics with a gradually increasing conductivity gradient from the front to back layer of the composite and ~85% and ~93% average absorption was achieved without and with a metal sheet placed at the back of the composite.



SYNTHESIS AND CHARACTERIZATION OF GRAPHENE REINFORCED Al-7.5 WT.% Zn MATRIX COMPOSITES

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The use of aluminum and its alloys in the automotive, aerospace and defense industries, especially in areas where advanced material properties are needed, is limited due to their low strength and durability. To improve their mechanical properties, alloying elements and reinforcement materials are added into the Aluminum matrix. Zinc is one of the important alloying element for the Al-matrix for improving strength and enabling precipitation hardening of Al alloy.

Graphene, which is one of the strongest materials per unit weight with nanoparticle size, has the potential to be an important reinforcement material for Al-based composites. Among carbon-based reinforcement elements, graphene has a higher distribution in the matrix compared to carbon nanotubes thanks to its wrinkled surface structure, and it can transfer its high mechanical properties to the structure by holding on to the matrix better. In this study, Few-Layered Graphene (FLG) reinforced Al-7.5 wt.% Zn-xFLG (x= 0, 0.5, 1, 2 and 5 wt.%) alloys are fabricated via powder metallurgical route from their elemental powders and the effect of FLG amount and milling time were investigated. Few-Layered Graphene is synthesized by the electric-arc discharge (EAD) method.

To prepare composite powders, mechanical alloying method was applied in a SPEX-type ball mill with 1200 rpm and 8:1 ball-to-powder ratio. Synthesized powders were compacted via uniaxial hydraulic cold press under 650 MPa pressure as cylindrical samples (ϕ 12 mm). Compacted samples were subjected to debinding treatment to remove stearic acid, which were carried out at 425 °C for 2 hours in a MSE tube furnace under flowing Ar atmosphere and they were pressurelessly sintered at 565°C for 2 hours in a Protherm tube furnace with flowing Ar gas at a 5 °C/min heating and cooling rate. The microstructural investigations on the mechanically alloyed (MA'ed) and as-blended (non-MA'ed) powders were conducted via X-Ray Diffractometer (XRD) and Scanning Electron Microscopy (SEM). Sintered samples originated from MA'ed and non-MA'ed powders were characterized in terms of microstructural and mechanical properties via X-Ray Diffractometer (XRD) and Scanning Electron Microscopy, density via Archimedes' density method and microhardness (Vickers), reciprocating wear and compression tests.

According to the phase and microstructural analyses results, FLG-reinforced Al-Zn alloy powders with an average particle size of 1 to 40 microns were successfully synthesized via mechanical alloying process. Zinc particles were homogenously distributed in the Al matrix according to the SEM-EDX analysis. As a result of XRD analysis, it was determined that a small amount of aluminum carbide phase formed in the structure. The hardness values of alloys increased from 80 HV up to 180 HV with increasing amount of FLG in the Al-Zn matrix. Also, wear properties of FLG-reinforced Al-Zn composites were improved with increasing amount of FLG. Also, compression strength of composites reached to 287 MPa via addition of 1 wt.% FLG to the Al-7.5 Zn matrix.



MECHANICAL PROPERTIES OF Si_3N_4 REINFORCED Ti6AL4V COMPOSITE FOAM

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In this study, Ti6Al4V (Ti64) foams and Ti64-Si₃N₄ composite foams were produced with a porosity of 70% by volume by powder metallurgy and space holder method. The effects of Si₃N₄ reinforcement ratios (1%, 3%, 5% and 7% by weight) on % relative density ratio, % porosity ratio, hardness, compressive strength and microstructure properties of composite foams were investigated comparatively. As a result of the analysis, the highest increase in compressive strength compared to Ti64 foam materials was observed with an increase of 35.34% in Ti64-Si₃N₄ composite foams reinforced with 1% Si₃N₄. The best hardness value was obtained with 7% Si₃N₄ reinforced Ti64 matrix composite foams with an increase of 111.60% compared to Ti64 foams.



BIODEGRADABLE POLYMER NANOCOMPOSITES USING MODIFIED CELLULOSE NANOCRYSTALS

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Cellulose nanocrystal (CNC) can be a good nanofiller in polymer matrices thanks to its superior properties. However, its hydrophilic nature cause agglomeration in polymer matrices. To eliminate this, poly(glycidylmethacrylate) (PGMA) modification on CNC surface was carried out in this study. After that, poly (butylene adipate-co-terephthalate) (PBAT) was used as polymer matrix to understand the improvement of CNC dispersion. Also, it is aimed to improve the rheological and other properties of PBAT by improving dispersion. Thanks to PGMA modification, chemical bridge can be created between CNC and polymer matrix and hydrophilicity can be decreased with PGMA chains on CNC surface. CNC dispersion quality in nanocomposites were compared through rheological analysis. Also, TGA and DSC analysis were conducted to determine thermal properties.



WHITE MUSSEL SHELLS POWDER AND INDUSTRIAL HEMP OIL FOR THE PRODUCTION OF PVA COMPOSITES

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The climate change, it is an extremely complex problem that is at the forefront of the most important environmental and economic problems of our age, and that has negative effects in every aspect of life, especially from health to agriculture. Due to climate change, it is important to prevent rapid consumption of natural resources for sustainable development. In this context, about 300 million tons of polymeric materials are produced every year around the world. However, none of the commonly used plastics has degradation in a short time by itself in nature. For these reasons, research on the development of biodegradable plastics gains importance in order to overcome the environmental problems caused by plastics. In the present study composites are produced by the addition of industrial hemp oil and the mussel shells powders in the matrix of PVA (Polyvinyl alcohol). PVA is a water- soluble, synthetic and thermoplastic polymer which is colorless, odorless, non- toxic and not polluting the environment. It has properties of adhesion, film formation, isolation and resistance to oils. Hemp is a fiber plant that obtains fiber from the hemp stem and oil from its seed. The average oil rate is 30- 32 %, and it has significant contributions to the food, cosmetics and other industries with its unsaturated fatty acids ratio. Therefore strengthen bones. The shells of mussels represent the major part in terms of weight (56- 61%), and also the major component of the shell composition is calcium carbonate (around 94%). The provided powders and composites were analyzed by XRD, and SEM to observe crystal structure and particle morphology of the samples. In terms of the methods and materials used, it has been tried to obtain green and sustainable polymer products in accordance with the Green Deal, and Climate Change Plan. Thus, the disadvantages caused by polymer materials to nature could be minimized and cleaner products, less waste and, less raw material would be used.



INVESTIGATION OF THE EFFECT OF COPPER ALLOY REINFORCEMENT ON THE PHYSICAL PROPERTIES OF POLYMER MATRIX COMPOSITE

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Polymer materials are used in many sectors such as automotive, machinery, aviation and medical due to their easy forming, recycling, reuse and strong characteristic properties with their affordable cost. The properties of polymer materials such as thermal, mechanical and electrical conductivity can be improved by using these materials as polymer-metal, polymer-polymer, polymer-fiber composites. This makes polymer composites the preferred material for many specific applications. In this study, PE and PP were used as matrix materials. Reinforced copper alloy CuCrZr powder particles were added at a rate of 0.5%-1%-3%-5% by weight. The materials were granulated using a twin screw extruder. Then, test coupons were printed with an injection machine. Molded samples; melt flow index, moisture absorption, thermal distortion temperature, vicat softening temperature, wear rate, static and dynamic friction coefficient and scanning electron microscopy (SEM) tests were carried out. The results of the tests were examined and the effects of copper powder supplementation on polyethylene and polypropylene were investigated. According to the results of the tests, it was determined that with the increase of copper powder ratio in the matrix, the moisture absorption value decreased, while the thermal distortion temperature, vicat softening temperature, melt flow index, friction coefficient and wear rate values increased.



MICROCELLULAR HEMP FIBRE REINFORCED POLYPROPYLENE MATRIX COMPOSITES

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Microcellular nature fiber reinforced polymer materials have significant application especially automotive industry because of their advantages such as their reducing weight and improving strength of components through microcellular structure, process and product. This research investigates chemical foaming agent types and their contents (1-2-3%wt.) impacts on physical properties of hemp fibre reinforced PP composites. Water absorption test, melt flow index test (MFI), density, Vicat softening temperature, heat deflection temperature (HDT), water absorption test would done. The morphology of the microcellular hemp fibre composites were examined using scanning electron microscopy (SEM) to observed cell morphology cell size, shape, and distribution of cells account for physical properties behavior.



A STUDY ON THE MATERIAL PROPERTIES OF CARBON NANOTUBES DOPED GLASS FIBER REINFORCED NANO COMPOSITES

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Türkiye

Fiber based laminated composites show relatively low out of plane/through thickness properties because of weak fiber/matrix interphase. In this study, it has been aimed to improve the through thickness properties of Multi Walled Carbon Nanotubes (MWCNTs) doped Glass Fiber Reinforced Polymers (GFPCs) produced by using different production methods such as Mechanical Mixing Method and Spray Method. Also, surfactant has been used to distribute MWCNTs more homogeneously. To see the effects of these methods on the properties of the composite materials, several mechanical testing and material characterization have been conducted. As a result of the conducted studies, best flexural strength and flexural modulus are obtained by Spray Method with the aid of surfactant. Also, increases observed on hardness of composite materials produced by both Spray and Mechanical Mixing Methods as compared to control sample. The SEM images revealed that the best dispersion of MWCNTs in the structure are obtained with Spray Method.



SYNTHESIS OF BORON-CONTAINING COMPOSITE MATERIALS IN THE SOLID-FLAME COMBUSTION MODE

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The production of composites based on $\text{TiB}_2\text{-Al}_2\text{O}_3$, $\text{CrB}_2\text{-Al}_2\text{O}_3$, $\text{B}_4\text{C-Al}_2\text{O}_3$ in the solid-flame combustion (SHS) mode with the use of preliminary mechanical activation (MA) of the initial components has been studied. It is important to use the available borate ore of the Republic of Kazakhstan.



COMPATIBILIZED PLA/TPU BLEND SYSTEMS AND THEIR NANOCOMPOSITES WITH NANOCCLAY

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In this study effects of Cloisite 30B (C30B) nanoclay and chain extender (Joncryl) incorporation on the mechanical and morphological properties of PLA/TPU blends was investigated. Polymer blends were prepared with blending ratio of 75 wt%/25 wt% (PLA/TPU) with different amount of Joncryl contents. Samples were prepared with using different TPU (ether/ester) and PLA grades (amorphous/semicrystalline). Afterwards the study was carried out focused on investigating the effect of varying blend ratios on the mechanical and morphological properties of PLA/TPU blends. Finally PLA/TPU blend nanocomposites were prepared with fixed blending ratio (75 wt%/25 wt%), at different C30B loadings (1,3 and 5 wt %) with/without compatibilizer. The dramatic increase in toughness and strain break values were observed in PLA/TPU (75 wt%/25 wt%) blends with 0.5 wt% Joncryl addition while the further amount of Joncryl addition has adverse effects on mechanical properties. Moreover in the case of nano clay incorporation the synergistic addition of Joncryl and C30B resulted in further decrease in droplet sizes and enhanced mechanical properties compared with incompatibilized counterparts.



INVESTIGATION OF THE MECHANICAL PROPERTIES OF THERMOPLASTIC BASED SANDWICH STRUCTURES PRODUCED BY FUSED DEPOSITION MODELING (FDM) TECHNIQUE

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Lightweight sandwich structures are used widely in the aerospace and automotive industries due to its high energy absorption capacity, superior thermal insulation, high impact and bending resistance. The sandwich structures basically consist of core and surface layers. The basis of core structures which developed as a result of numerous analytical and experimental studies consists of porous cellular geometries. Recently, conventional fabrication techniques are insufficient due to production of complex cellular core structures and reduction of the core sizes geometrically. Therefore, the desired core topologies have started to be produced by using the fused deposition modeling (FDM) technique which is one of the additive manufacturing (AM) methods. FDM three-dimensional (3D) technologies, which are superior to conventional fabrication methods with their features such as reducing costs, manufacturing complex products with high precision and eliminating additional processes provide many advantages. In this study, which is proposed based on the present literature researches, sandwich structures with different core geometries will be produced by using an FDM-based 3D printer. The influence of different core structures like honeycomb and auxetic on the properties of acrylonitrile butadiene styrene (ABS), polycarbonate (PC) and polystyrene (PS) thermoplastic sandwich panels processed by fdm will be investigated. the mechanical behavior of these samples will be tested under quasi static-dynamic loads and structural characterizations of the manufactured samples will be carried out in detail. It is aimed to increase the structural and mechanical strength of the samples manufactured according to the determined optimum 3D process parameters (layer height, infill rate) by achieving high energy absorption and high impact resistance values.



MECHANICAL CHARACTERIZATION OF GRAPHENE NANOPLATELETS/Al₂O₃ REINFORCED EPOXY HYBRID COMPOSITES

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The mechanical behavior of epoxy matrix composites containing two different fillers is presented in this work. The mechanical characteristics of epoxy composites are affected differently by Aluminium oxide (Al₂O₃) and graphene nanoplatelet (GNP). Al₂O₃ (1 to 5 wt.%) and GNP (0 to 1 wt.%) reinforced epoxy matrix composites were produced with sonication and stirring magnetic route. Mechanical and microstructural properties of composites were investigated via Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), hardness and tensile test. The highest ultimate tensile was found 62.83 for 3 wt.% reinforced Al₂O₃ epoxy matrix, and it was observed that there was a 38% increase compared to neat epoxy. The best hardness was found for 3 wt.% reinforced Al₂O₃ and 0.25 wt.% GNP reinforced composites, and there was a 22% increase in hardness compared to neat epoxy.



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INDUSTRIAL WELDING APPLICATIONS OF S690QL GRADE STEELS

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As the structural steel solutions become more challenging in the market, higher stresses need to be overcome by the most efficient joint details and the most feasible material selection. Using higher thickness material not only makes the joints more critical, but also increases the amount of material and causes much more emission of carbon to the atmosphere during the production of the steel for the related scope. High strength material usage reduces the weight of the structure, reduces the amount of welding and also reduces the emission of carbon. However, welding high strength materials is challenging and special precautions need to be taken during fabrication. Most of the precautions are already defined and declared by the standards, codes and specifications, but the fabrication requires some extra measures especially against hydrogen cracking. This study summarizes some critical fabrication measures to be taken while working with S690QL grade steels. They may also be beneficial and applicable for higher grade steels.



INVESTIGATION OF MICROSTRUCTURE AND MECHANICAL PROPERTIES OF DP QUALITY STEELS WELDED WITH DIFFERENT HEAT INPUTS

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Due to climate changes, Automobile industry reduces the weight of automobiles. It causes the increasing usage of High Strength Steel. DP steel is a part of high-strength steel. Welding is an essential key role in that industry. The welding methods are investigated TIG and MAG which includes CMT and pulse arcs. TIG and MAG have different heat inputs that cause different microstructure and mechanical properties. These investigation purposes are that compare the welding methods and understand metallurgical changes and mechanical properties in structure.



THE EFFECT OF PROCESS PARAMETERS ON BEAD GEOMETRY, HARDNESS AND MICROSTRUCTURAL PROPERTIES ARMOUR STEEL WELDS PERFORMED BY ROBOTIC GAS METAL ARC WELDING

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The robotic welding operations have received a great deal of attention since they are highly appropriate both to increase in production rate and quality for desired products used in defence industry. Therefore, selection of an optimum combination of welding parameters is critical in achieving high weld quality and productivity. In this study, the effects of robotic gas metal arc welding (GMAW) process parameters such as current and welding speed on bead geometry, hardness and microstructural properties of the weldment were investigated. The bead on plate technique was used to deposit weld metal on the Protection 500 series armour steel plates having 6 mm thickness. The ER307 austenitic solid wire with a diameter of 1.2 mm according to AWS A5.9 standard were used as filler metal under the 97.5 % Ar + 2.5 % CO₂ mixture of shielding gas atmosphere. The welded plates were first subjected to visual inspection and radiographic examination to detect any imperfections described in ISO 5817 and ISO 10675-1, respectively. Then detailed characterization of the sectioned samples was conducted using a stereo microscope, optical microscope, and micro-hardness tester. As a result; the different responses such as depth of penetration, reinforcement area, bead width, heat-affected zones, and hardness profiles were compared and results were correlated with microstructures. The obtained results revealed that process parameters have significant effect on bead geometry and hardness values.



DESIGN OF HIGH STRENGTH AND HIGH TORQUE RESISTANCE WIRE ROPE

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Steel wire ropes are critical load bearing elements in a wide range of applications such as elevators, cranes, mining operations, bridges and ships. The aim of this study is the design of wire rope, prototype production, performance measurements and the development of a wire rope with commercialization potential, especially in mobile cranes operating over 60 meters. Outputs of this study have provided torque-rotation resistance and strength properties above the performance properties of imported steel ropes used in mobile cranes and become a product with commercialization potential. The products that are equivalent to the rope in question have a high Sunday share in Asia, Europe and America, and there are limited compositions and limited production opportunities in our country.



EFFECTS OF BUILD ORIENTATION AND PROCESS PARAMETERS ON MECHANICAL BEHAVIOR OF IN718 COMPONENTS MANUFACTURED BY SELECTIVE LASER MELTING METHOD

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In recent years, additive manufacturing techniques have created new opportunities for the production of critical metallic components having extremely complex shapes and functionally graded layers. IN718 has gained importance in aerospace, nuclear, and energy industries due to its excellent mechanical behavior at elevated temperatures. In additive manufacturing of IN718, localized fast-melting/solidification, micro segregation, etc. create several risks such as anisotropic behavior and reduced mechanical properties. In addition, the presence of the brittle Laves and acicular δ phases affect machinability negatively. The aim of this study is to investigate the effects of build orientation and process parameters on the microstructure and mechanical properties of IN718 alloy manufactured via Selective Laser Melting.



THE EFFECT OF HEAT INPUT ON MECHANICAL PROPERTIES OF TRIP STEELS IN GMAW AND TIG WELDING

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The effect of heat input on mechanical properties was investigated in GMAW and TIG welding of TRIP steels. To ensure the effectiveness of the developed procedure, all TRIP steel plates were single-pass welded and thermal cycle data were recorded from different points located on the surface of the welded plates. In the experimental part, thermal cycle profiles were obtained by taking temperature measurements at a distance of 1-2-3-5 mm from the fusion line in GMAW applications and 3-5-7-9 mm from the fusion line in TIG welding applications, taking into account the heat input. Thermal cycles were obtained by using 4-channel k-type thermocouples at different welding speeds. Mechanical tests and microstructural examination were carried out in accordance with the ISO/IEC 17025 standard. The results were discussed to evaluate the effect of heat input on the thermal cycle profiles of GMAW and TIG welded TRIP Steel sheets as a function of welding speed.



THE EFFECT OF BRAZING PARAMETERS ON THE MICROSTRUCTURAL FEATURES OF ALUMINA-COPPER JOINTS

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Oxygen free copper and alumina ceramic are brazed by using filler alloy with composition 72 wt% silver and 28 wt% copper under high vacuum (~10⁻⁵ mbar) conditions. Different brazing temperatures and times are experimented for this study to see the effect on microstructure and unity of the joints because these are the main parameters influencing elemental diffusion.



NON-DESTRUCTIVE DETECTION OF FLAWS IN CONDUCTIVE SEALANT APPLICATIONS WITH A METAMATERIAL BASED ANTENNA

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In this study, we have designed a metamaterial based antenna which can be used to determine application errors for conductive sealant on metal plates. This type of applications are common on aircrafts to maintain conductivity on the surface. During the application of conductive sealant, there might be some holes with different shapes and imperfection which must be determined particularly through non-destructive methods. In this method, the imperfections on the application of conductive sealant on metal plates and around fasteners are determined using the resonance frequency changes on the metamaterial-based antenna. In order to increase the sensitivity of the determination system, the magnitude changes on return loss behavior of the designed antenna are also considered for different error scenarios. These scenarios include different shapes and location of errors on the application of conductive sealant between two metallic plates and around a fastener. In all scenarios, the imperfections on the application of conductive sealant can be determined highly effectively without damaging the applied area by only placing the measurement system close to the area to be measured. Another advantage of the designed system is that it can be adopted to other fillers in order to determine application error for different applications.



PROPERTIES OF LASER WELDED 3003 ALUMINUM ALLOY

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Technological developments in the production industry have led to the improvements for welding processes. Despite the disadvantage of high initial setup cost, laser welding method is on the rise due to its advantages such as increasing the amount of work done per unit second, increasing the quality of welding, and no requirement of consumable, amongst the fusion type of welding processes. In this study, similar welds have been produced by fiber laser welding using 1.4 mm thick 3003 series aluminum alloys. The optimization of the welding parameters is accomplished by Taguchi method and the mechanical and microstructural properties of the welded joints have been examined.



EFFECT OF POST WELD STRESS RELIEVING HEAT TREATMENT ON 6XXX SERIES ALUMINUM ALLOYS

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Türkiye

6XXX series aluminum alloys are alloys containing aluminum, magnesium, silicon with relatively higher mechanical properties and can be heat treated. The strength losses that will occur after welding these alloys can be eliminated by heat treatment. In this study, two 6082 aluminum alloys in the form of plates were welded by MIG method and stress relieving heat treatment was applied for 30 minutes at 175°C, which is the parameters used in industrial painting. It has been determined whether the temperature has an effect during the dyeing process in the bake hardening process. Then, rupture, hardness and microstructure analyzes were performed on the samples. According to the test results, stress relieving heat treatment at the specified parameters after welding decreased the shear force and elongation, while increasing the hardness in the weld base metal and the weld area.



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SURFACE MODIFICATION OF 3D-PRINTED POROUS 316L STAINLESS STEEL

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Metallic biomaterials are extensively used to meet the demands in orthopedic applications. For patient specific implant fabrication, three-dimensional (3d) printing systems have been investigated in the last decade. In fact, 3d printing allows fabrication of metallic implants that match the anatomy of the damaged hard tissue, which enabled improved bone regeneration for the patients. Aside from the appropriate implant geometry, surfaces of the implants also play an essential role in integration of the implant with juxtaposed bone tissue (osseointegration). To enhance the interactions between the implant and bone tissue, implant surface can be modified. One of the promising techniques to modify the surfaces of metallic implants is anodization. Anodization can be used to modify the surfaces of metallic implants in the nanoscale. In fact, the surface of the 316L stainless steel (316L SS), a commonly-used low-cost metallic implant material having appropriate mechanical properties and high machinability, can be altered via anodization to provide nanostructured surface topography.

In this study, porous 316L SS samples were manufactured with Direct Metal Laser Sintering (DMLS) method. For this purpose, computer-aided design (CAD) model of the sample was sketched and porous parts were printed according to this design. A porous morphology with 700 μm pore size was selected to reduce the elastic modulus difference between the bone and implant material. Moreover, the porous structure of the implant material was expected to improve the osseointegration between the bone tissue and the implant material. Afterwards, the printed porous 316L SS samples were anodized. Different process parameters were implemented to observe the structures forming on the material surfaces. These parameters were the electrolyte concentrations, applied voltage and anodization duration. The formed structures on the anodized samples were examined with Scanning Electron Microscope (SEM). It is observed that columnar shaped nanostructures developed on the surface according to the altered process parameters.



CHARACTERIZATION OF COPPER NANOPARTICLE-DEPOSITED BIOCERAMIC COATINGS FABRICATED ON ZIRCONIUM

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The commercial pure zirconium (Zr) was coated by micro arc oxidation (MAO) in solution, consisting of calcium acetate and β -calcium glycerophosphate salt. Then, copper nanoparticles (CuNPs) were deposited at different by electrochemical deposition (ED). The phase structure, surface morphology, elemental composition and wettability of both coatings were characterized by XRD, SEM, EDS and contact angle goniometer, respectively. The XRD results indicated that zirconia, calcium zirconate and hydroxyapatite were detected on the surfaces. The coating surfaces were rough and porous. Also, CuNPs was randomly distributed through the whole surface. In vitro antibacterial test of all surfaces was carried out for Gram positive (*S. aureus*) and Gram negative (*E. coli*) bacteria.



PRODUCTION AND CHARACTERIZATION OF BIOACTIVE GLASS-CERAMICS FROM SODA-LIME-SILICA AND BOROSILICATE WASTE GLASSES

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In this study, bioactive glass-ceramics are aimed to be produced by waste glasses to ease bioactive glass-ceramic production and transform waste glasses into high-valued products. Two bioactive glass compositions have been studied; the first one is the well-known 45S5 and the second one is the newly determined 23B23S. Also, compositions from pure oxides were prepared to compare with waste glasses. High degradation rate and hydroxyapatite (HA) layer formation was observed after (simulated body fluid) SBF immersion. The formation of a thicker layer was observed with increasing soaking time.



ESSENTIAL OIL-LOADED POLYMERIC FOAMS VIA GREEN ROUTE

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An ideal wound dressing in the wound healing process should be able to create biocompatible structured matrixes that can retain moisture, prevent bacterial adhesion, and prevent environmental threats. In this study, collagen and biocompatible polyvinyl alcohol (PVA), which have recently been used quite widely in wound healing processes, will be used as a matrix material. Although PVA and collagen polymers are used alone as matrix materials for the purpose of ideal wound dressing, their combined use will contribute to the development of the physical properties of the final wound dressing to be produced. However, since PVA/collagen (PVA/COL) wound dressings cannot provide all the requirements and it is necessary to obtain topical foams by enriching them with the active ingredient citral essential oil. In this study, the morphological, thermal, spectroscopic analysis, and antibacterial activities of the foam materials that will be obtained according to different amounts of essential oils by preparing Pickering emulsions will be evaluated.



PRODUCTION AND CHARACTERIZATION OF Ti-6Al-4V SLURRY FOR TRABECULAR DENTAL IMPLANTS PRODUCED BY REPLICA IMPREGNATION METHOD

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Recently metallic foams have been in demand for several application because of their superior properties such as lightweight, high compression strength, low thermal conductivity, good energy absorbtion. The trabecular implants, made of titanium and its alloys, have some important properties such as high corrosion resistance, suitable mechanical properties, good biocompability, etc,.They have been extensively used as biomaterials. Trabecular implant provides the bone to move into the implant and thus better anchoring, result in a longlife of implant, can be ensured.

In this study, metallic foam to be used as implants will be produced with Ti6Al4V alloys by replica impregnation method that is relatively easy and cheap. In production process, the effect of binder, sintering time and sintering temperature will be examined. High strength will be anticipated with high sintering temperature and time.



SURFACE INVESTIGATION OF ANTIBACTERIAL COPPER-INCORPORATED BIOACTIVE SURFACES FABRICATED ON COMMERCIAL PURE TITANIUM

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In this study, as a first step, a copper (Cu) thin film layer was deposited on cp-Ti (Grade-2) by thermal evaporation-physical vapor deposition (TE-PVD). And then, the Cu-based titanium surface was coated by micro-arc oxidation (MAO). The phase structure, surface morphology, elemental composition, functional groups, wettability and surface topography of both coatings were characterized by XRD, SEM, EDS-mapping, contact angle goniometer, ATR-FTIR and surface profilometer, respectively. The XRD results indicated that anatase and rutile were detected on the surface after MAO and TE+MAO. Both coatings' surfaces were rough and porous due to plasma chemical reactions on micro discharge channels. The Cu-incorporated MAO coating exhibited much more hydrophilic character than MAO coating, and the Cu was homogeneously distributed through the surface.



ANTIMICROBIAL PROPERTIES OF ELECTROSPUN NANO-SIZED Ag AND TiO₂ BLENDED PVA NANOFIBERS

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In the present study, the effect of concentration and electrospinning parameter variations on poly (vinyl alcohol) (PVA) nanofibers was investigated. The diameters and morphological properties of the obtained nanofibers were determined using scanning electron microscopy (SEM), and the average fiber size was measured with the Image J program. The optimum PVA nanofiber production conditions were determined as 425.30 ± 58.59 nm, for %10 wt./v concentrations at 0.5 ml/ h and 9kV. Nano-sized silver (Ag) and titanium oxide (TiO₂) were blended into PVA solution with different concentrations and electrospun at optimum conditions. Additionally, the antimicrobial attitude of Ag and TiO₂ blended PVA nanofibers was analyzed by using the agar disc diffusion method, and antimicrobial activity against gram - (Escherichia coli; ATCC 25922) and gram + (Staphylococcus aureus; ATCC 25923) was observed.



A GREEN MANUFACTURING METHOD IN SKIN TISSUE ENGINEERING

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In this study, sodium caseinate/gelatin-based scaffolds were fabricated and crosslinked with microbial transglutaminase (mTg) (4% w/w). Sodium caseinate (NaC) was mixed at a concentration of %16 (w/w) inside deionized water. The dynamics of enzymatic cross-linking activity was evaluated with different concentrations of sodium caseinate. Apart from many other enzymes, microbial transglutaminase has the ability to be active even below freezing temperatures. By keeping it at -59°C for 24 hours, the enzymes were still active to complete the post-crosslinking process. Cell activity and characterization tests were conducted and it was observed that these scaffolds could have very promising applications in skin tissue engineering.



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A PLATFORM OF 3D PRINTED ENERGY STORAGE DEVICES TO POWER WEARABLE DEVICES

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3D-printing is regarded as a sustainable manufacturing technique with applications in different industries, from automotive to aerospace, medicine and energy. It presents different advantages, such as reduced cost, design freedom, weight reduction and localized production. 3D printing can enable the fabrication of miniaturized batteries and supercapacitors with free form factors, high mass loading electrodes over small footprint areas. We aim at establishing 3D printed aqueous based batteries to be used to power wearable devices where safety, availability of raw materials and conformal features are critical. We use earth-abundant, non-hazardous electrode materials and water-based electrolytes to meet the growing energy demand to power wearable and portable electronic devices. In this talk I will present our work on 3D printed energy storage devices in the form of supercapacitors and rechargeable batteries beyond lithium. I will discuss the materials challenges in formulating inks of 2D materials and different architectural design to optimize the electrochemical performance. I will then discuss how these devices can power wearable sensors for a prolonged period of time.



PRODUCTION OF NANO STRONTIUM HEXAFERRITE BY SOLUTION COMBUSTION SYNTHESIS

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In this study, we produced strontium hexaferrite magnets with different metal doped via solution combustion synthesis technique using strontium nitrate ($\text{Sr}(\text{NO}_3)_2$), iron (III) nitrate ($\text{Fe}(\text{NO}_3)_3$) and citric acid ($\text{C}_6\text{H}_8\text{O}_7$). Calcium nitrate tetrahydrate ($\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$), chromium (III) nitrate nonahydrate ($\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$) and manganese (II) nitrate tetrahydrate ($\text{Mn}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$) were used as additives in the production of doped magnets. Magnets produced during the studies were annealed at different temperatures and various analyzes were made. X-Ray Diffraction (XRD) was used to determine the phases in strontium hexaferrite ($\text{SrFe}_{12}\text{O}_{19}$), Master Sizer analysis to determine grain sizes, and Fourier Transform Infrared Spectrometer (FTIR) analysis to determine chemical bonds.



PHASE ENGINEERING OF SEMICONDUCTOR NANOSCALE MATERIALS

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It is well known that phase structures and their fractions for nanoscale materials affect the efficiency of output in different application areas in a positive way. Therefore, the utilization of materials with different phases and their fractions together is very intense. Intensive studies are carried out to produce hybrid structures with different phases and/or fractions in order to boost nanoscale materials application. In this context, the adjustment and calculation of phase transformation and ratios by applying the thermal expansion method for powder materials has been evaluated. The results obtained from thermal expansion method were compared with the results of XRD technique in order to confirm. The results showed that the adjustment of phase fractions might be performed during the process without using XRD.



EFFECT OF STARTING COMPOSITION ON THE MORPHOLOGY OF SOL-GEL SYNTHESIZED BORON CARBIDE (B_4C) PARTICLES

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In the present work, the effect of the starting materials and composition on the B_4C formation and its final particle morphology was investigated. The particle size and shape of boron carbide powders were tailored by controlling the polymeric network of the gel using carboxylic acids with different molecular structures. Polymeric gels were fabricated using boric acid, glycerin, mandelic acid, and tartaric acid as starting materials in different ratios. The pyrolysis process of the synthesized gels was carried out at 675 °C, followed by heat treatment on pyrolyzed processors at 1500 °C for 5h in an Ar atmosphere. The results showed that the formation of fiber, rod, plate, and equiaxed boron carbide particles was observed. In addition to morphology, acids and their ratios were also found to be effective in boron carbide transformation.



THE SYNTHESIS & CHARACTERIZATION OF HOMOGENOUS HIGH-QUALITY GRAPHENE ENCAPSULATED METALLIC POWDERS VIA PLASMA ENHANCED ROTATING CVD

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Graphene, the two-dimensional allotrope of carbon, holds a great potential to be a solution for various problems faced by both scientists and industries owing to its superior mechanical properties, electrical and thermal conductivity. Recently, graphene encapsulated powders have attracted attention since it is possible to harvest graphene's potential on a large scale; however, current processing techniques are limited to top-down methods and do not match all the requirements; especially synthesis of high-quality graphene without undesired functional groups and defects, large-scale production, and low cost. In this study, a cost effective and novel method is proposed to synthesize high quality graphene encapsulated metal powders at low temperature via plasma enhanced chemical vapor deposition (PECVD). The mechanical properties are measured with compression and tension tests and thermal resistivity of graphene encapsulated powders are studied with laser flash method. The results are compared with the samples without graphene.



NEW POLYMORPHS OF COMPOUNDS WITH A COMPLEX, LAYERED CRYSTAL STRUCTURE STABILIZED AT THE NANOSCALE: MAGNETIC STRONTIUM-HEXAFERRITE NANOPLATELETS AND FERROELECTRIC BISMUTH-TITANATE NANOWIRES

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Jožef Stefan Institute
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During wet-chemical synthesis, metastable polymorphs frequently nucleate before the stable phase due to a lower nucleation barrier. These metastable polymorphs stabilized at the nanoscale represent some of the technologically most important nanomaterials, e.g., photocatalytic anatase and magnetic maghemite nanoparticles. However, such nanomaterials are not restricted to simple oxides. We will present new polymorphs of two technologically important materials with a complex, layered crystal structure; magnetic strontium hexaferrite (SHF) and ferroelectric bismuth-titanate (BIT), synthesized using a hydrothermal method. The SHF polymorph was stabilized in the form of small nanoplatelets and the BIT polymorph appeared in the form of nanowires. The new crystal structures were characterized using a combination of atomic-resolution scanning-transmission electron microscopy, X-ray diffractometry and Raman spectroscopy. Magnetic properties of the SHF nanoplatelets were measured with VSM magnetometer and the ferroelectric properties of the BHF nanoplatelets were characterized with polarization force microscopy. Special focus of the presentation will be on the role of the metastable polymorphs for the synthesis of new nanomaterials. The discovery of new polymorph demonstrates the immense potential of the stabilization of new metastable polymorphs of complex functional materials for the discovery of new nanomaterials.



PRODUCTION OF TIN NANOWIRES VIA AAO TEMPLATE METHOD AND INVESTIGATION OF THEIR PERFORMANCE AS CATALYSIS FOR ELECTROCHEMICAL CO₂ REDUCTION

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Electrochemical CO₂ reduction is known as one of the promising methods to deal with anthropogenic CO₂ at the atmosphere. However, insufficient current density obtained during the reduction continues to keep this technique a step back in large scale applications when compared to the electrolyzer and fuel cell systems. To overcome this problem, production of nanostructured electrocatalyst having high surface to volume ratio has been proposed. An easy and low-cost technique for fabrication of nanostructured electrocatalyst is a highly desirable goal. Anodic oxidation of aluminum is a versatile way to produce uniform and highly-ordered patterns for serving as a template for nanostructured materials. However, formation of barrier non-conductive oxide layer at the bottom of the pores on AAO film has to be eliminated to perform electrodeposition on the pattern. In this study, tin nanowire electrodes were produced using AAO templates to obtain electrocatalysis having high effective surface area for electrochemical reduction of CO₂ to formate. To perform an efficient electrodeposition of tin using AAO template, zincating process, which was proposed firstly in our group as an alternative way to handle the barrier oxide layer, was used. The self-standing tin nanowires produced by electrodeposition into zincated AAO template gave substantially higher currents per geometric surface area than the bulk electrodes with the same geometrical area. Moreover, the amount of formate produced during electrochemical CO₂ reduction was 4 times higher than the bulk tin plate electrodes. This work indicated that tin nanowires produced this method can be a strong candidate as electrocatalysts for CO₂ reduction.



THE SYNTHESIS AND CHARACTERIZATION OF Mo_2CT_x MXENE BY HYDROTHERMAL ETCHING WITH DIFFERENT FLUORIDE SALTS FOR EMI SHIELDING APPLICATIONS

**Elif OKAY¹, Ömer Refet ÇAYLAN¹, Begüm Beril İNCECİK²,
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Türkiye

Mxenes are the novel two-dimensional metal carbides or nitrides derived from their MAX phases. Recently discovered mxenes attracted the attention of many researchers and are widely studied for the applications of energy storage, catalysis, gas sensing, wastewater treatment etc. More than twenty Mxenes have been successfully synthesized and Mo_2CT_x holds great potential due to its theoretically predicted electrochemical, thermoelectric properties and chemical stability. Nonetheless, the long synthesis duration which can amount up to several days due to the strong bonding between the Mo- Ga atoms is challenging. In order to overcome this problem, in this study, hydrothermal etching has been used to lower the duration drastically.



EFFECT OF CALCINATION TEMPERATURE ON MgAl_2O_4 NANOPARTICLES PRODUCTION BY SOL-GEL METHOD

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Spinel MgAl_2O_4 nanoparticles have attracted considerable research interest since they can be used in a wide variety of applications such as refractory linings, catalysis and sensors. In this study, MgAl_2O_4 nanoparticles were prepared by sol-gel method. Crystal growth and structural properties of MgAl_2O_4 nanoparticles obtained after different calcination temperatures (600–800 °C) for 3 h were investigated. The prepared powders were characterized by differential thermal analysis (DTA), X-ray diffraction (XRD), scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS), Fourier transform infrared spectroscopy (FT-IR).



COMPARATIVE STUDY OF MICROSTRUCTURAL CHANGES AND HARDNESS OF NANOSTRUCTURED FECOCRNI HIGH ENTROPY ALLOYS AFTER DIFFERENT CONSOLIDATION ROUTES

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Türkiye

In this work, mechanically alloyed nanocrystalline FeCoCrNi HEAs were consolidated via cold compaction following conventional sintering and spark plasma sintering. The results showed that spark plasma sintering yielded higher density with increasing temperature. Microstructurally, SPS route resulted in increased amount of Cr-rich carbide second phases in the microstructure, which yielded higher hardness, when compared to the conventional sintering route.



DEVELOPMENT OF GRAPHENE/SILICON COMPOSITE BASED LITHIUM ION BATTERY ANODE

**Tarık Can TÜRKOĞLU, Eren ATLI, Ömer Refet ÇAYLAN,
Göknur CAMBAZ BÜKE**

TOBB University of Economics and Technology
Türkiye

The need for energy storage devices is growing constantly, requiring the development of more efficient, high-capacity batteries. Due to their superior properties compared to conventional batteries, lithium-ion battery cells have become the most popular energy storage units, and they are now widely used. The Li-ion battery cells used in electric cars are expected to have a short charging time, a long cycle life, a low weight/volume, and a large storage capacity. The anode structure of Li-ion batteries should be enhanced to obtain these features. Because of its large surface area, mechanical and electrical capabilities, and chemical resistance, graphene has potential to solve challenges. Top-down processes such as high vacuum furnaces, and the flash method are used to make Gr for Gr/Si composites.



LASER INDUCED GRAPHENE STRUCTURES FOR ELECTROCHEMICAL SENSING DEVICES

**Murat DEMİREL, Ömer Refet ÇAYLAN, Tarık Can TÜRKOĞLU,
Göknur CAMBAZ BÜKE**

TOBB University of Economics and Technology
Türkiye

Flexible electronic devices demonstrate great impact in wearable electronics and sensors therefore they are attracting significant attention from both academia and the industry. Humidity sensors are the most important members of these devices due to their fast response speed, low cost and outstanding stability with high performance, since the demands in various applications have been increasing such as water status tracking of plants, health monitoring via respiration detectors, environmental monitoring. In this study, 3D porous graphitic carbonaceous structure is synthesized and patterned on nail polish via laser induced graphene (LIG) technique with 405 nm Nichia blue laser to fulfill the demands of the humidity sensor properties. In addition, commercial humidity sensors are coated with LIG and the performance difference between as-received sensor and LIG coated sensor is compared with the arduino electronic platform.



PHOTOLUMINESCENCE PROPERTY OF NaYF₄: Yb/ Er/ Pr UPCONVERSION NANOPARTICLES IN THE NEAR INFRARED REGION

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Türkiye

Upconversion nanoparticles (UCNPs) have emerged as potential luminous nanomaterials due to their unique properties, allowing them to overcome many issues plaguing traditional fluorescence probes. UCNPs have been employed in a variety of applications, but it is arguably in the realm of sensing where they have shown the most promise. Under near-infrared (NIR) stimulation, up-conversion nanoparticles (UCNPs) release not only ultraviolet/ visible (UV/Vis) light but also have the potential to emit near-infrared light. These features of UCNPs ushered in a new era in nanoparticle development as a probe capable of extracting critical data from the target. As a result of their remarkable features, UCNPs have emerged as interesting options for luminous biosensors in biomedicine and biotechnology. It's worth remembering that current technology is considerably more focused on nanoparticles that emit near-infrared light. Different forms of near-infrared emission nanoparticles have demonstrated themselves for excitation (NIR I) and emission in the infrared range(NIR-I, NIR-II). Due to their low toxicity, deep tissue penetration, and excellent photostability, NIR I-II emitted nanoparticles have been proposed as promising options for biomedical sensing and imaging. UCNPs become effective instruments due to their excellent physic-chemical features, including a large anti-Stokes spectral shift, good photobleaching resistance, long luminous lifetime, great luminous lifetime chemical stability, and narrow emission band. The present research reports the monodispersed, well-shaped, with a high crystalline hexagonal phase of NaYF₄: Yb³⁺/Er³⁺/ Pr³⁺ were synthesized successfully via the thermal decomposition technique. Synthesized upconversion nanoparticles were achieved in the average size of 20 nm. Photoluminescence properties of nanoparticles have been studied. Significant emission peaks have been observed at 520nm, 540nm, 654nm, and 840nm under the 980nm excitation wavelength. In the case of comparison, the photoluminescence property was studied under different Pr dopant concentrations in NaYF₄: Yb³⁺/Er³⁺/ Pr³⁺. Research aimed to study the effect of Pr dopant concentration on emission intensity at the 800 nm region.



THE SYNTHESIS & CHARACTERIZATION OF CARBON NANOTUBES ON SiC VIA VACUUM DECOMPOSITION

**Erhan GÜRPINAR, Ömer Refet ÇAYLAN, Derya KARADENİZ,
Erkin Köseoğlu, Göknur CAMBAZ BÜKE**

TOBB University of Economics and Technology
Türkiye

Due to their unique properties such as excellent electrical and thermal conductivity, high mechanical strength, good chemical stability, and a high aspect ratio, carbon nanotubes (CNTs) have been considered as the most promising candidate for field emitters. Vacuum annealing of silicon carbide, one of the most popular synthesis methods of CNTs, is advantageous in many aspects since it does not require the use of a catalyst, enabling producing CNTs with high purity and adhesion strength, among other properties. In this work, carbon structures (graphite, graphene, and CNTs) have been synthesized on silicon carbide using vacuum annealing, and the effects of different process parameters such as synthesis duration, temperature, pressure, gas mixtures, and flow rates on the synthesized structures are investigated. The morphology of carbon structures is examined using SEM, and Raman spectroscopy.



FABRICATION OF GRAPHENE-METAL POWDER COMPOSITES AND THEIR EMI SHIELDING PROPERTIES

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Electromagnetic interference (EMI) shielding is the phenomenon of electromagnetic waves being reflected and neutralized by absorption and reflection in a substance. Due to their high electrical conductivities, metallic materials are widely utilized in these applications. Graphene is another material with promising prospects for EMI shielding applications. Large-scale graphene production is achievable via wet chemistry techniques. Metal/graphene composites are synthesized by mechanical alloying. In this study, Graphene Encapsulated Copper (G/Cu) composites have been fabricated by ball milling, and their characterization and EMI-SE have been investigated.



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CIRCULAR ECONOMY IN METAL FOUNDRY SECTOR: FROM EUROPE TO TÜRKİYE

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The circular economy is a new economical behavior system to reduce the wasting of all components of a system that includes reducing, reusing, recycling, and refurbishing-remanufacturing. The compound annual growth rate of global resource extraction is realized as 1.8% from 1980s to 2020. Minerals, metals, glass and plastics, paper, and wood are recycled, composted, and/or reused as 43.8%, 4.3%, 1.1%, and 3.6%. Linearity occurs in the metal casting sector that wastes can be summarized as glue, sand, slag, catalyst, gas-washing fluent and cleaning consumables 4.61%, 4.53%, 4.37%, 4.33%, 4.23%, 4.19% of total waste, respectively. Green deal is a milestone of new and updated process designs. In consonance with green deal protocols, European Union generates more than 25 communications, directives and regulations which are consisting of bans on plastic materials in daily life, regulating the waste collection and recycling method, and eco-design requirements. Also, Türkiye follows European Union Green Deal approaches and there are many different projects implemented via the Ministry of Environmental and Urbanization supported projects that can be implemented from micro to macro levels. Also, The Circular Economy Platform was established in 2016 with the support of the Business Council for Sustainable Development Türkiye (BCSD Türkiye) and the European Bank for Reconstruction and Development. In this study, circular economy approaches, and main concepts are reviewed per metal foundry process.



OPTIMIZING THE AMOUNT OF FLUX USED IN THE CASTING PROCESS OF EN AW 6082 ALUMINUM ALLOY IN PROFILE PRODUCTION

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The use of quality melt is necessary to obtain a product with the high mechanical properties. In order to improve the quality of the molten metal, an efficient degassing process must be applied to remove slag and oxides from aluminum alloys prior to casting. In the degassing process, parameters such as gas, degassing time, degassing flow rate, amount of flux used affect the efficiency of the process. Various fluxes (casting chemicals) are used in order to remove oxidized structures, impurities and unwanted elements in the melt, to make the melt suitable for casting and to cut off its contact with the atmosphere. Within the scope of the study, the effect of the flux ratios used on the efficiency of the profile production process was examined. In this direction, all other parameters in the degassing process were kept constant, the effects of flux ratios at different rates were determined. In the study, EN AW 6082 aluminum alloy was used. In the degassing process, 3 different parameters (5, 8.5 and 10 kg) were applied. In line with the samples obtained, tests and analyzes such as bifilm index calculation, determination of density values, tensile test, hardness test, chemical analysis, microstructure analysis were carried out. In the results of working, the optimum flux usage amount was determined. The problems that occur as a result of the use of flux have been eliminated. Thus, a more efficient degassing process has been realized.



REDUCING THE ENERGY COSTS FOR GREEN CONVERSION BY COATING THE SURFACES OF THE CRUCIBLES USED IN HPDC METHOD WITH BORON REINFORCEMENT CELLULOSE

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Due to their weight/strength properties, aluminum alloys are widely used in the automotive, aviation, home appliance, hardware, etc. sectors, where weight reduction is very important. In addition to the production of aluminum alloys with various production methods, high pressure casting method (HPDC) is widely preferred in terms of its suitability for mass production. The melted liquid metal in the melting pot is taken to the holding pot and kept at a constant temperature value. While the liquid metal is kept in the crucible, it is necessary to keep the crucible at a constant temperature in order to prevent problems that will affect the product quality due to the frequent wear of the materials on the surfaces of the crucible, and most importantly, the high heat transfer inside the crucibles. It takes a lot of energy for this system. It is desired to reduce this excess energy and the associated cost. In this study, in order to reduce the carbon footprint and reduce energy costs within the scope of sustainability, cellulose added boron material was coated as an intermediate layer in the crucible. In order to carry out the trials, a crucible was built in the size that the applications can be made. The inner surface of the crucible is filled with coating material. The coating material consists of cellulose wool obtained from the recycling of newspaper papers and boron additives produced entirely by domestic means. The coating material is natural, organic and also has heat and sound insulation properties. As long as it does not come into direct contact with the liquid metal, its thermal insulation and flammability are very low. In addition to having a low thermal conductivity coefficient, it provides high efficiency thermal insulation by keeping the heat of the air-conditioned environments for a longer time with its high heat storage capacity. In the sound tests, it was seen that as the thickness increases according to the coating thickness, the sound permeability of the crucible improves by 30%, while it provides significant gains in thermal insulation. While the study continues, it is thought that it will provide a significant gain, especially in terms of sustainability and energy costs, especially when evaluated in terms of sectoral preference.



MICROSTRUCTURE EVOLUTION OF THE THREE-PHASE $\text{Al-Al}_2\text{Cu-Ag}_2\text{Al}$ EUTECTIC SYSTEM UPON DIRECTIONAL SOLIDIFICATION

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Fundamental understanding of the microstructure formation during solidification is of interest from scientific and practical perspectives since the solidification microstructure controls many properties of the alloy. In addition to the process parameters such as alloy composition, solidification methods, and parameters, gravity-induced effects have dramatic impacts on microstructure formation. While many studies have been focused on single-phase and two-phase microstructures, the microstructure evolution during the solidification of multi-phase alloy systems is less understood. The multiplicity of phases and associated interphase boundaries add more complexity to the interpretation of the reasons behind the formation of a specific solidification microstructure. In this study, the $\text{Al-Al}_2\text{Cu-Ag}_2\text{Al}$ three-phase eutectic system is used as a model alloy to tackle questions on multi-phase microstructure forming in coupled growth.

The existence of an invariant ternary eutectic point, as well as reliable thermodynamics databases, make this system ideal to investigate the evolution of three-phase eutectic solidification. The Bridgman-type directional solidification setup was utilized to solidify as-cast cylindrical samples at a constant temperature gradient and various velocities. Later, the samples were metallographically prepared for microstructural analysis. The existence of three phases and three interphase boundaries lead to the formation of the variety of complex microstructures which in turn leads to outstanding challenging in the quantitative characterization of the microstructures. We first developed a method to define the eutectic spacing in the most observed microstructure so-called chain-like structure and correlated the eutectic spacing to the solidification velocity.

Subsequently, we defined morphological parameters to distinguish various microstructures. In addition to the effect of the experimental parameters, such as velocity, on the microstructure, we observed a severe effect of gravity, i.e. elemental segregation and enhanced convection in the liquid. This was pronounced in the experiment that was run for a relatively long time. It comes clear that the interpretation of three-phase eutectic growth and solidification microstructures without eliminating the effects of gravity lacks accuracy. This alloy system is used to perform experiments on board of the International Space Station (ISS) under μg condition. Preliminary data analysis shows that the most observed microstructure, i.e. chain-like structure, was formed under μg condition as well. Ongoing investigations on μg -microstructures along with the analysis of the earth-microstructures shall shed light on the formation and stability of the three-phase eutectic microstructure. In sum, this study aims to show the complexity of the interpretation of the three-phase eutectic solidification microstructures not only due to the nature and dynamic behavior of the three-phase growth, but also additional uncontrolled parameters induced by gravity.



OPTIMIZATION OF THE HEAT TREATMENT PARAMETERS DEPENDING ON THE THICKNESS IN PLATE PRODUCTS MADE OF EN AW 1050 AL ALLOY

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Rabia Şevval AKAN^{2,3}, Ayberk UZER^{2,3}, Muhammet ULUDAĞ^{2,3}**

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Türkiye

Many of the engineering metals and alloys become industrially usable after one or more heat treatments. Heat treatment is a process applied to improve the mechanical properties (hardness, strength, etc.) of metals. Aluminum sheet material can be produced in many different thicknesses according to the usage area. Plates with different thicknesses produced from the same alloy should be heat treated with different parameters, because as it is known, the thickness of the material is one of the parameters affecting the heat treatment. Within the scope of the study, optimization of the heat treatment process parameters to be applied to 0.80 mm and 1.65 mm thick plate products made of EN AW 1050 (H24 condition) aluminum alloy used in the plate production facility was provided. The heat treatment parameters to be applied are: temperature parameter of 270 °C and 280 °C, and time parameter of 3 and 6 hours for each temperature. Mechanical and chemical tests and analyzes (bifilm index calculation, density calculation, tensile test, hardness test, chemical analysis, microstructure analysis) were applied to the non-heat-treated and heat-treated samples. As a result, optimum heat treatment temperature and duration were determined for plates with different thicknesses.



UNDERSTANDING THE SOLIDIFICATION DYNAMICS OF COMMERCIAL ALUMINIUM ALLOYS PRODUCED BY TWIN-ROLL CASTING

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Twin-roll casting (TRC) is a proven technology for sheet production. Several aluminum alloys with a narrow freezing range from the ternary Al-Fe-Si systems have been traditionally produced by TRC. Microstructural features and, therefore, properties of the final product of TRC are strongly affected by the casting process parameters, hence, the cooling rate through the thickness. Due to the high cooling rates (>100 K/s) employed in the TRC process, the produced sheets have rapidly solidified surfaces. The solidification rate decreases as the liquid metal moves away from the rolls to the center of the sheet metal. The change in the cooling rate encountered through the thickness of the solidifying metal not only results in changes in grain structure but also changes the distribution and morphological features of secondary phase particles (SPP). Unfortunately, up to our best knowledge, there is no study in the literature that can quantify the effects of cooling rate on the microstructure evolution at different sections of the TRC strips through the thickness. In this study, Bridgman-type directional solidification (DS) setup with liquid-metal cooling (LMC) was used to mimic the solidification microstructure and estimate the through-thickness cooling rates of the TRC strip. 1xxx and 8xxx aluminum alloys, which are industrially produced into sheets using the TRC process, were employed for this purpose. During directional solidification experiments, velocities as fast as 50 mm/s were achieved, thanks to LMC, to be able to reach the cooling rates of the TRC process. Velocity is found out to be the primary process input parameter that significantly affects the thermal field during DS. It determines the shape of the isotherms and influences the compositional homogeneity at the solid/liquid (S/L) interface. The isotherm curvature affects the temperature gradient and hence cooling rate at different locations of directionally solidified samples. As a result, after characterization of various features such as the size, aspect ratio, and characteristic length scale of SPP, S/L interface curvature is directly related to the grain structure and morphological features of the microstructure.



EFFECT OF CHROMIUM ON WEAR RESISTANCE OF CARBIDIC AUSTEMPERED DUCTILE IRON (CADI)

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Türkiye

Carbidic austempered ductile iron (CADI) is a type of ductile iron (DI) that contains carbides, providing strengthened wear behavior, compared to traditional austempered ductile iron (ADI). The presence of carbides in the structure increases the wear resistance. However, it was found that ADI has a better impact toughness than CADI.



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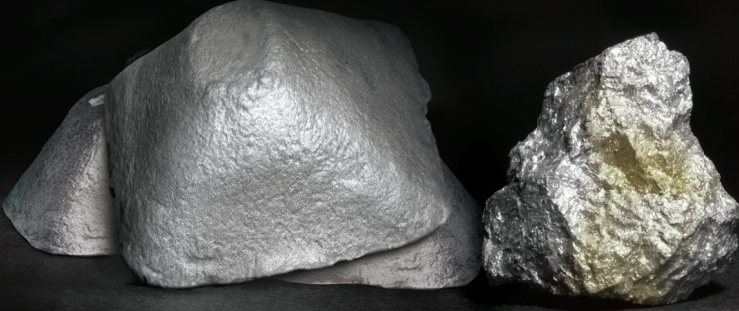


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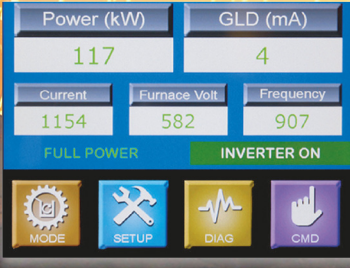
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Tam 77 yıldır ülkemizin geleceğine yatırım yaparak yerel katma değerin artırılması için aralıksız çalışıyoruz.

Yenilikçi yaklaşımımız, nitelikli çalışanlarımız ve fark yaratan çalışmalarımız ile Türkiye ekonomisine güç vermenin gururunu yaşıyoruz.

Dün olduğu gibi yarın da aynı cesaret ve sorumlulukla sürdürülebilir bir gelecek için çalışmaya devam edeceğiz.



Ergitme Operasyonlarınız için gelişmiş dijital kontroller

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NON FERROUS

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Chrome Metal
Magnesium Metal
Manganese Metal

BASE METALS

Aluminium
Nickel
Copper
Lead
Zinc
Tin

MINOR METALS

Antimony Metal
Cadmium Metal
Chromium Metal
Cobalt Metal
Manganese Metal
Molybdenum Metal
Niobium Metal
Selenium Metal
Silicon Metal
Wolfram Metal
Zirconium Metal

MASTER ALLOYS

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Aluminium Titanium Boron
Aluminium Chrome
Aluminium Manganese
Aluminium Silicon
Aluminium Strontium
Silicon Calcium
Calcium Carbide
Aluminium Nickel
Aluminium Cobalt
Copper Phosphorus

PIG IRON

Nodular Grade Pig Iron
Foundry Grade Pig Iron
Basic Pig Iron
Steel Scrap

INOCULANTS

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Ferro Silicon Zirconium
Ferro Silicon Barium
Ferro Silicon Aluminium
Ferro Silicon Calcium

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Chromite Sand
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Ferro Chrome
Ferro Molybdenum
Ferro Vanadium
Ferro Phosphorus
Ferro Titanium
Ferro Boron
Ferro Sulphur
Ferro Niobium
Ferro Wolfram
Ferro Nickel

NON FERROUS

Silicon Metal
Chrome Metal
Magnesium Metal
Manganese Metal

BASE METALS

Aluminium
Nickel
Copper
Lead
Zinc
Tin

MINOR METALS

Antimony Metal
Cadmium Metal
Chromium Metal
Cobalt Metal
Manganese Metal
Molybdenum Metal
Niobium Metal
Selenium Metal
Silicon Metal
Wolfram Metal
Zirconium Metal

MASTER ALLOYS

Nickel Magnesium
Aluminium Titanium Boron
Aluminium Chrome
Aluminium Manganese
Aluminium Silicon
Aluminium Strontium
Silicon Calcium
Calcium Carbide
Aluminium Nickel
Aluminium Cobalt
Copper Phosphorus

PIG IRON

Nodular Grade Pig Iron
Foundry Grade Pig Iron
Basic Pig Iron
Steel Scrap

INOCULANTS

Ferro Silicon Magnesium
Ferro Silicon Zirconium
Ferro Silicon Barium
Ferro Silicon Aluminium
Ferro Silicon Calcium

MINERALS/ORES

Chromite Ore
Iron Ore
Manganese Ore
Fluorspar
Alumina / Bauxite

WATER TREATMENT

Ductile Iron Pipe
Aluminium Sulphate
Chlore

OTHERS

Graphite Electrode
Metallurgical Coke
Foundry Coke
Silicon Carbide
Chromite Sand
Magnesium Granule
Graphitized Petroleum Coke
Calcinated Petroleum Coke
Steel Shot
Steel Grit
Foundry Resin
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